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FORMERLY



The . . .
Underground
Water . . .
Preservation
Association,

ON

The . . .
**UNDERGROUND
WATER SUPPLY
OF THE COUNTRY.**

EDITED BY
CLAYTON BEADLE, F.C.S.
AND
WM. MAY, F.R.G.S., F.G.S.

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The Underground Water Preservation Association,

ON

THE UNDERGROUND WATER SUPPLY

12

SCIENCE NOTES.

It is a matter of common knowledge that fruit juices exert a most beneficial effect in the treatment of scurvy and similar ailments, and their action on the typhoid bacillus and the colon bacillus, which are the cause of many forms of acute intestinal and other diseases, has been studied on a considerable scale by Dr. Reynolds, Health Commissioner of Chicago. He finds that the juices of different species of lemons vary very materially in germicidal effect, that from some specimens requiring as much as 10 per cent. to kill all the exposed germs. Lime juice, apple juice, and grape juice all have a more or less inhibiting effect, but the bottled grape juice sold at grocery stores gave the most conclusive results. Distilled and tap water were infected with the bacteria, and bottled grape juice added in proportions varying from 1 to 5 per cent. Examination showed that some brands had killed the germs at the end of the first minute, as did also the lemon juice of a proper strength. Strangely enough, the freshly-extracted juice of the grape, prepared in the laboratory, had no effect, even in a proportion of 100 per cent.

Concurrently with the proposals to municipalise the water supply of London comes the far-reaching suggestion to nationalise all underground waters. Taking the records over a long period, from 1865 to 1871 there was an average rainfall, from 1872 to 1886 the fall was 8 per cent. in excess of the average, but from 1887 to 1901 there was a deficiency of 8 per cent. Many persons consider that this shortage is due to deforestation and to better drainage, which allows water to run off the land more quickly. But coincident with these natural effects spread over wide areas, there are artificial ones operating more powerfully in special localities. The requirements of the ever-increasing population of the Home Counties have demanded greater supply, and pumping operations have seriously lowered the level of underground water. Dr. Bruckner, in his work on "Variation of Climate," computes that the dry cycle is an average of eighteen years, and the wet and dry cycle one of 35½ years. If that be so, the present dry period ought to come to an end about 1905 or 1906, and the years from 1906 to 1921 should be wet.

The ventilation of Cornish mines forms at present

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Underground Water Preservation Association.

The UNDERGROUND WATER PRESERVATION ASSOCIATION formerly the Kent Water Preservation Association is formed for the purpose of preventing the abstraction of Water by Water Companies to the detriment of Landowners, Millowners, and others, and conserving the waters of any district for the use of its own inhabitants.

In joining the Association no liabilities are incurred beyond the payment of an annual subscription.

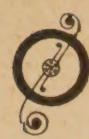
The amount of annual Subscription is voluntary with a minimum of £1 1s. 6d. per annum. It is to be hoped that those who have large interests which are likely to be preserved by the work of the Association, will contribute liberally to its support.

The subscriptions are paid into the General Funds of the Association.

The General Fund is devoted to the organization work of the Association, which comprises the following :—Prospecting and surveying for the purpose of ascertaining the available underground water supplies, and the probable effect which the operations of Water companies may have upon the same, Keeping the records of rainfall, measurement of the flow of rivers, and permanent levels in wells, and such other information and records which would be of service to the Association in the prosecution of its work, especially records of the known depression in the chalk water level under London.

All members have the advantage of any records, reports, surveys, &c., made by the Association.

Members, by joining in and assisting the combination of interests formed by the Association, will, while adding to its strength and efficiency, aid in securing for themselves the great benefits which its legal action may afford, in supporting, promoting or opposing any bills before Parliament which are likely to affect the main object of the Association.

 F recent years there has been much discussion about the drying up of the country which has been almost universally attributed to a deficiency of rain. The object of this pamphlet is to show the main cause of what has already become a very disastrous state of affairs in the Home Counties, as well as in many other parts of the country. It is the desire on the part of those who have taken part in the initiation of this movement to take an unbiassed view of the subject as far as possible. With this object the Executive Committee have, before expressing their views, made the most careful researches into available publications bearing on the subject, not only into publications by those who hold the same views as are and have been advanced by this Association, but also by those who have for so long upheld the view that the underground reservoir under London is practically inexhaustible.

The following is a brief sketch of the events which have given rise to the formation of the Underground Water Preservation Association.

In consequence of the rapid drying up of a well known Kentish stream Mr. Clayton Beadle, as representing one of the local authorities affected, read a paper before the Sanitary Congress held in London in 1901.

In dealing with the rights of underground Pumping in relation to the flow of neighbouring streams and confining his observations to the River Cray, his main contention both in the paper and the discussion which followed, was, that after making due allowance for percolation, the deficiency of rainfall of recent years could not account for the drying up of certain streams, and these arguments were strengthened by the fact that a previous and similar drought had not brought about the same state of affairs as exists at the present time.

Following on the publication of this paper the matter was strongly contested by one of the Directors of the Kent Water Company, whose views on the subject were in opposition. In order to reply to his various criticisms Mr. Beadle went further and more minutely into the subject, with the result that he felt more than ever confident that he was fully justified in the opinions that he expressed at the Congress. As a result of this controversy a great deal of interest was taken in the subject by the inhabitants of Kent, more especially by those living in the district supplied by the Kent Water Company.

In order to get a more general expression of opinion it was thought advisable to call a meeting, and accordingly a meeting was held at Cannon Street Hotel, on April 9th, which was numerously attended.

The following is a List from among those who either attended or wrote in support of the meeting:

Earl Stanhope.	Rt. Hon. J. G. Talbot, M.P.
Sir William Hart Dyke, M.P.	Sir Patteson Nickalls.
Sir Mark Collett.	Sir James Whitehead.
Sir Samuel Scott.	Mr. W. Q. Orchardson, R.A., Dartford.
Colonel W. F. Tipping.	Rev. H. Rashleigh.
Rev. H. F. Marriott Smith.	Mr. J. Armstrong, Farningham.
Mr. G. M. Arnold, Gravesend.	Colonel Kidd, J.P., Dartford.
„ T. C. Colyer-Fergusson.	Mr. Coles Child, J.P., Bromley.
„ E. J. Elgood, J.P., Sidcup.	„ W. Chambers, Southfleet.
„ E. Packe, Bromley.	„ A. H. Baker, Beckenham.
„ J. J. Hewitt, Stone.	Rear Admiral Miller, Sevenoaks.
„ H. J. Bristow, Bexley Heath.	Mr. A. M. Fleet, Darenth.
„ J. T. Fairbank, Chislehurst.	„ G. Norman.
„ Charles Beadle, J.P.	„ A. Vinson, Belvedere.
„ W. J. Thompson, Sevenoaks.	„ C. H. Watson, Greenhithe.
„ N. Watney, Westerham.	„ C. L. Wilson, Beckenham.
„ R. Whyte, Chislehurst.	„ W. May, St. Mary Cray.
„ R. Gordon, J.P., Chipstead.	„ A. Brown, Orpington.
„ H. E. Beadle.	„ T. Bowyer, Wilmington.
„ J. S. Bligh, Sevenoaks.	„ E. Cronk, Seal.
„ W. Cook, St. Mary Cray.	„ G. Day, Wrotham.
„ G. Dark, Chipstead.	„ D. T. Corke, Foots Cray.
„ J. Russell, Sutton-at-Hone.	„ Vavasour Earle, Farningham.

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„ Hollingworth & Co.	...	...	Maidstone	...	„
„ H. Allnutt & Son	...	...	Tovil	...	„
„ A. E. Reed & Co.	...	...	Tovil & S. Darenth		„
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„ Basted Paper Mills Co.	...	...	Nr. Sevenoaks	...	„
„ George Wilmot	...	...	Nr. Sevenoaks	...	„
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„ R. D. Turner & Co.	...	...	Nr. Tonbridge	...	„
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„ W. Howard & Son...	...	...	Nr. Canterbury	...	„

EARL STANHOPE wrote:—" Though I am against the exhaustion of the water in streams and wells, I happen to be one of the Directors of the Kent Water Company. The water drawing area of the Metropolis will have to be clearly defined by the Committee considering the Water Bill introduced by the Government."

MR. COLES CHILD, Bromley, wrote: "I fear that I cannot attend the meeting on April 9th. I have heard that the complaint contained in your letter is universal in the neighbourhood of London, not only is the ordinary water supply failing, but wells are ceasing to flow for a considerable distance round the Thames and New River watersheds."

COLONEL C. E. WARDE, M.P., wrote:—"I quite realize its importance and shall be happy to co-operate with Sir William Hart-Dyke, or other country Members who may interest themselves on the subject."

SIR WILLIAM HART DYKE, wrote:—"I think a meeting to consider the Government Bill should be held, and I shall attend if possible."

MR. TOLHURST wrote saying:—"Springhead stream has been absolutely sucked dry by the Kent Water Company's Pumping Station near by, and the famous watercress beds have been completely ruined, and property which before has brought in a rental of £400 or £500 a year, has been correspondingly damaged. I certainly think there ought to be some protection against this kind of damage to property, but what is of still greater importance in my estimation is that water belonging to the neighbourhood should not be taken from us because it happens to be cheaper and handier to do so, for distribution in a neighbourhood we are not interested in."

MR. ALGERNON FLEET wrote:—"In the parish of Darenth we have already suffered much from the two pumping stations that have recently been erected there and at the Grange and in several other places affected, we are at the present moment laying water on, in fact I believe there is scarcely a well in the parish that has not been dried up or seriously diminished by the many water works in the district. I regret that the matter has not been taken up before as it is undoubtedly a great injury to the whole neighbourhood."

Similar letters were received from Mr. Hesketh, Mr. W. Q. Orchardson, R.A., and Mr. Colyer-Fergusson and others.

The following Local Authorities have passed Resolutions and expressed themselves in sympathy with the work of the Underground Water Preservation Association.

Kent County Council.	St. Mary Cray Parish Council.
Bexley U. District Council.	Beckenham U. District Council.
Chislehurst U. District Council.	Dartford U. District Council.
Bromley R. District Council.	Dartford R. District Council.
Bromley U. District Council.	Stone Parish Council.
Shoreham Parish Council.	Sevenoaks U. District Council.
Farningham Parish Council.	Eynsford Parish Council.
Farnborough Parish Council.	Southfleet Parish Council.
Crayford Parish Council.	Foots Cray U. District Council.
Otford Parish Council.	Maidstone R. District Council.
Erith U. District Council.	Commissioners of Dartford and Crayford Navigation.

THE TERMS OF A FEW OF SUCH RESOLUTIONS
ARE AS UNDER:—

KENT COUNTY COUNCIL,—“ It was resolved that the Committee objects to the provisions in the said Bill by which it is sought to extend the limits of the Company for the supply of water and to empower the Company to acquire further works, plant and pipes, together with the lands on which same works have been constructed, the Committee being of opinion that no further powers should be conferred on the Company for the abstraction of water, the rivers and springs in the area of the Company having been already seriously affected by the Company's operations ”

BECKENHAM URBAN DISTRICT COUNCIL.—“That in the opinion of this Council the further depletion of the wells and streams of Kent by the pumping operations of the Water Company for the supply of other districts should be prevented by legislation (2) That the aims and objects of the Kent Water Preservation Association are worthy of support and are officially endorsed by this Council.

BROMLEY RURAL DISTRICT COUNCIL.—“The objects of the Kent Water Preservation Association have the warmest sympathy and moral support of the Council, and they are strongly in favour of all measures which aim at preserving the water supply of Kent for the residents within the County.”

CHISLEHURST URBAN DISTRICT COUNCIL.—“It was resolved that this Council gives its sympathy and moral support to the Kent Water Preservation Association.”

STONE PARISH COUNCIL.—“That in the opinion of this Council the depletion of wells in the district by the erection of Pumping Stations by the Kent Water Works Co., is a matter of serious injustice to the ratepayers, and the Council earnestly hope that the efforts of the Kent Water Preservation Association will put a stop to such injustice.”

ST. MARY CRAY PARISH COUNCIL.—“That the Kent Water Preservation Association has the sympathy and moral support of this Council in their endeavour to limit the amount of water taken from this district by the Kent Water Company.”

SHOREHAM PARISH COUNCIL.—“That this Council unanimously agrees with the Association in protesting against the Water Companies obtaining immense quantities of water which is detrimental both to our village and the whole County.”

The chair was taken by R. B. Berens, Esq, J.P., who was also supported by Lord Avebury and other influential landowners, as well as by the leading millowners in the county of Kent. As a result of the

meeting it was unanimously resolved to form an Association; and for this purpose a number of gentlemen were appointed, as an Executive Committee, from among those who attended this meeting, to carry this into effect. A few days afterwards as a result of this, the Kent Water Preservation Association was formed.

The Association very soon enrolled a number of influential Members, a list of whom, together with subscriptions and donations and amounts guaranteed will be found at the end of this pamphlet.

The first active step the Association took was to appeal against the Kent Water Bill, which was about to be heard before a Select Committee of the House of Lords, consisting of the following Members :

Lord Brougham & Vaux, *Chairman*

Lord North.

The Earl of Romney.

Lord Colchester.

Lord Muncaster.

The Bill had passed the Committee of the House of Commons and it was seen that the Kent Water Company had obtained powers to raise £150,000 for such purposes as their Capital might properly be expended upon.

The Association retained Lord Robert Cecil as senior, and Mr. Clarke Williams as junior counsel, and Mr. Urban Smith, Mr. G. R. Strachan and Mr. Thomas Hennell to give expert evidence.

After a strenuous fight the Lords Committee granted the Association a *locus standi* and as the result of the opposition which lasted about a week, an important clause was finally inserted as an Appendix to the Bill, which will serve very materially to help the objects of the Association and protect the inhabitants of the district.

The Lords Committee directed that :—

“ Particulars and estimates of the improvements, extensions and expenses contemplated in the Company's undertaking

should be furnished and inserted as an Appendix to the Bill in order to prevent and prohibit the application of any portion of such Capital (£150,000) to any purpose other than the completion of the works and wells already authorised by Parliament and which cannot be postponed, and the proper distribution by the Company of water to the consumers in their district."

At the Meeting on the Monday following, to settle the clauses directed to be brought in by the Lords Committee the Kent Water Company again endeavoured to obtain power to use a portion of the £150,000 for purposes other than the works specified; this of course was strongly objected to on behalf of the Association as not being within the decision of the Committee, and after a long argument the Committee upheld their decision and limited the monies to be raised to the works specified in the Schedule.

The new clause incorporated in the Bill restricts the Company to the works as scheduled therein to be paid for out of the £150,000 and any premiums which may be obtained on the sale of stock, or so much of those sums respectively as will remain outstanding after giving credit for payments made on account thereof since the 12th March, 1902. And in payment of the costs, charges and expenses of and incident to the preparing for obtaining and passing of the Act *and for no other purposes*.

This decision is most important, the result of it being that the expenditure is limited by Section 13 of the Kent Water Act, 1902, and the Schedule referred to therein to the actual items and amounts there set forth.

Two important points have been gained by the Association by their opposition to the Kent Water Bill.

1. The House of Lords recognised the objects of the Association, and gave them a *locus standi* in the face of the strenuous opposition of the Company.

2. The Association succeeded in materially limiting the powers of the Company as to its expenditure, and as a consequence no additional wells can be sunk without further enquiries being made regarding the abstraction of underground water.

From the facts gathered together to be used as evidence in the Association's opposition to the Kent Water Bill, it seems clear that the underground water supply is being exhausted, and that continuous pumping is causing great injury to many streams, wells and also to vegetation, and as a consequence to all persons and industries that have to depend upon the natural supply of water.

From the facts obtained it is perfectly clear that the abstraction of underground water is not only affecting the Kent Water Company's area but is damaging also the other Home Counties and that the question therefore becomes one of wide and national importance.

The Executive Committee accordingly decided to alter the name of the Association from that of the Kent Water Preservation Association to The Underground Water Preservation Association.

For many years geologists held that what is known as the London Basin is composed of a deep layer of chalk under the London clay, which is full of water and practically inexhaustable, but the facts now derived from Kent, Essex, Hertfordshire and Middlesex, near or on that basin, show that not only is the water in the basin exhaustible, but in many places it is rapidly becoming exhausted.

Until the Association raised its voice the effect of such exhaustion had scarcely been realised, although leading geologists and engineers had more than once given their warning. As it is evident that more water is being removed from the basin by one or other agency than can reach it through percolation from the rainfall, continuous and persistent pumping will at no distant date dry up the streams and rivers that derive their supply from the overflow of this basin.

The question that is submitted is one of the most serious importance, and the Executive Committee would be greatly obliged by anyone who is acquainted with the subject communicating any facts within his knowledge to the Secretary of the Association.

Much valuable evidence was accumulated by the Engineers and Experts employed on behalf of the Association, which throws considerable light on the subject of Underground Waters.

The Association instructed Mr. Urban A. Smith, C.E., 41, Parliament Street, Westminster, to report on the subject, and the following is substantially his report. Attention is particularly drawn to this as it clearly shows the disastrous results of depletion of the springs by pumping. We give here his report *in extenso* :

“I have carefully perused the Bill by which the Kent Water Company propose to acquire powers to raise capital for the execution of further works and to extend their limits of supply. The Bill does not fully disclose all the proposals of the Company, but I understand that the powers sought embrace the following :—

“To raise capital for the construction of—

(1)	A 30 inch main from Wilmington to Bridgen ...	£20,218
(2)	A similar main from Bridgen to Deptford ...	53,280
(3)	A 14 inch main from Overy Street, to West Hill, Deptford	1,500
(4)	New mains to Darenth and Green St. Green ...	2,055
(5)	Ordinary district mains for 2 years	20,000
(6)	Reservoirs (a) Shooters Hill Water Tower ...	5,000
	(b) Bickley	12,000

(7) New Pumping Stations at:—

(a) Darenth	...	...	...	...	10,150
(b) Crayford (Wansunt)	...	...	...	...	18,480
(c) Overy Street	...	...	...	...	2,000

“In addition to this the Company propose to purchase the Water Works owned by the Westerham Hill Park Estate (£6,000.)”

“I understand that the Company allege that these new works are necessary to carry them over the next two years, that is to May, 1904, and so enable them to perform their statutory duties.”

QUANTITIES OF WATER REQUIRED BY THE COMPANY IN FUTURE.

“The Committee on the London Water Bill, 1902, which Bill will presumably in some form or other become law this Session, have decided that the undertakings of the Water Companies, including that of the Kent Water Company, will be taken over by the newly constituted Authority on the 25th December, 1903, or such other day not being more than eighteen months later as the Local Government Board may appoint. This being so, a provision of water for the supply of the Company's district for three years from the present time, is the very outside limit that should be taken into consideration.”

“I consider that the Kent Water Company have, without any of these additional works, fully sufficient water to enable them to comply with their statutory obligations for three years, that is, to June, 1905.”

“In April, 1892, a statement was presented by the Company to the Royal Commission on Metropolitan Water Supply presided over by Lord Balfour of Burleigh, in which particulars of their wells and the quantity of water to be obtained from them, were given as follows:—

Situation.	No. of Wells.					Yield of Wells in use. Gallons per day.	
Deptford	...	...	3	...	...	...	8,000,000
Plumstead	...	...	1	...	...	...	800,000
Crayford	...	...	3	...	...	...	3,500,000
Shortlands	...	...	2	...	...	...	2,250,000
Orpington	...	...	2	...	...	...	2,500,000
Wilmington	...	...	1	...	...	...	4,000,000
Total	...		12				21,050,000

“The whole of these 12 wells were in use in April, 1892. The Company pointed out at that time how, by additional wells at some of these places, the quantities obtained might be increased.”

“In January, 1898, the Company laid further statements before Lord Llandaff's Commission, in which they shewed that they had sunk three additional wells, one at Southfleet, one at Kent Gate, (West Wickham) and another at Wilmington, the yield of these and the original wells being given as follows :—

Situation.	No. of Wells.				Average yield of wells in use. Gallons per day.
Wells in operation in 1892 ...	12	...	...	...	21,050,000
Wilmington (additional) ...	1	...	...	...	2,000,000
Southfleet	1	...	...	...	1,000,000
Kent Gate (W. Wickham) ...	1	...	...	...	1,000,000
Total ...	15				25,050,000

“In addition to the above wells in the chalk the Company have also a well giving a small supply at Westerham from the Lower Greensand.”

“At that time (January, 1898,) the Company had command of 25·05 million gallons of water per day, and—unless they have so drawn upon the natural reservoir of water in the chalk as to seriously deplete it, they still have such quantities available.”

“As regards the population to be supplied, I find that, in February, 1899, in the statement laid before Lord Llandaff's Commission, the Company estimated that upon the basis of the percentage of growth between 1881-1891 the increase in the future would be 30 per cent. per decade: but that calculated upon the basis of the increase in their supplies as shewn by the Company's returns between 1886 and 1896, the increase would be 24 per cent. per decade. The population supplied by the Company in March, 1902, was 611,856 and taking the larger figure of increase to arrive at the number of people to be supplied in the future there would be in June, 1903, 671,512 persons and the quantity of water required at 30 gallons per head would be 20,145,360 per day.”

“To cope with this demand the Company have, on their own showing, 25 million gallons per day.”

“In taking three per cent. per annum as the increase for the first part of the decade 1902-1912, I am estimating a higher rate of increase in the early years than the Company take, because the 30 per cent. is the result of a compound increase which would be clearly less than three per cent per annum, in the earlier part of the period, and more than three per cent. per annum in the latter part of the decade.”

“Again, in assuming the quantity required per head as 30 gallons, I am taking a figure well outside the mark, as Mr. Dickson, the Secretary of the Kent Company, before Lord Balfour's Commission stated that he considered that the amount of 30 gallons per head might be considerably reduced in the future.”

“As an additional margin for emergencies I should point out that the Company have available, without any of the works for which they now seek money, the following sources:—

An additional supply from Crayford of ...	1,000,000 gallons per day.
A supply at Charlton of	1,500,000 „ „
A supply at Belvedere	Quantity unknown.
A supply at Chislehurst	Quantity unknown.

Or a total of over 2,500,000 gallons per day.”

“The Company state that the well at Charlton, although not fit for general use, yields water that would be very suitable for street watering or other non-domestic purposes ; but in any case the additional water obtainable from Crayford would bring the available quantity of potable water in times of pressure to a total of 26 million gallons per day, as against the 20,145,360 gallons per day estimated to be required in June, 1905.”

“The foregoing calculations are based on the population actually supplied by the Water Company, and this is clearly the proper basis to take, and is the one that was taken by the Kent Company when calculating, before the Royal Commission of 1898, the amount of water required in the future ; but even were it the case that the whole of the population, including all persons in the Rural Districts, had to be supplied, there would still be ample water for them in 1905.”

“The Company showed that the whole population of their district had been increasing at the rate of 27·94 persons per decade.”

“This is arrived at by taking the decade rate of growth for the years 1881-1891. The whole population of the Company's district in 1891 was 491,652.”

“Upon this basis, the population in 1901 would have been 629,020, and in 1905 will be 699,344, which at 30 gallons per head will require 20,980,320 gallons per day, so that even if the present Company have not been bought up before 1905, and have to supply the whole of the population both in the Urban and Rural Districts, and moreover have to give each person 30 gallons per head per day, they will still have a margin, inasmuch as they have powers affording a supply, quite apart from the wells now in question, of 26 million gallons per day.”

“In all the above calculations of growth of population it will have been observed that I have taken as the basis the increase given by the Company, as having taken place between 1881 and 1891 ; but the Company are not entitled to claim the difference in population or of supplies between the numbers at these two dates for the reason that, in the year 1888, 50 square miles were added to the Company's District and the population in this area went to improperly augment the percentage of increase given. This was explained by Mr. Dickson, before the Royal

commission of 1893, and I gather from his evidence then given, that the increase, leaving out this augmentation, was nearer two per cent. per annum than the three per cent. I have taken. This makes my calculations still more favourable to the Company."

"The Company's Witnesses before the House of Commons Committee stated that there had been an abnormal rise in the number of the population to be served during the last five years. I find that this is so. In June, 1898, the population was 505,007, and in March, 1902, 611,856, an increase of 21·16 per cent. in the $3\frac{3}{4}$ years."

"I regard this as an abnormal increase for the particular period due, possibly, to the general dryness inducing people to take the Company's water who had previously relied upon other sources. But even if the increase of the population in the future takes place at this largely enhanced rate, there would still be ample water for the Company in June, 1905, as follows:—

"In March, 1902, the population was 611,856. A percentage of increase of 21·16 in $3\frac{3}{4}$ years is equivalent to an increase of 18·34 per cent. for the period of $3\frac{1}{4}$ years, that is from March, 1902 to June, 1905. $611,856 \times 18\cdot34$ per cent. increase would give a population of 724 070. This multiplied by 30 gallons per head makes a requirement of 21,722,100 gallons as against 26 million gallons per day available."

"OBJECT OF PRESENT BILL."

"In the Company's Bill, clause 20, there is a certain provision that nothing in the Act shall *authorise* the Company to make any claim in respect of the advantages conferred by the Act, but I cannot see that this has much practical effect. The Company do not require any special powers to give them authority to hereafter claim the full value of their undertaking, and the clause in question does not provide that the Company shall not make a claim; it only says that this particular Act does not give authority for such claim."

“The Engineer to the Company, Mr. Morr’s, when before the Committee of the House of Commons, said in effect that they were bound by statute to have water in hand for the supply of other Companies, and he used these words when being cross-examined by Mr. Wedderburn :—

“We are supposed to have at any rate a certain amount of
“reserve supply in hand with which we might be able to assist
“other Companies if the Local Government Board called upon
“us to do so.”

“The Metropolis Water Act of June, 1899, in my opinion puts no such liability upon the Water Companies. If required by the Local Government Board they are to carry out Works, and in cases of emergency, if they have more water than will satisfy the requirements of their own District, they are to sell such water to the other Companies. In any case the Company is not legally, and certainly not morally, bound to carry out any works for such purpose on the eve of being transferred to a new Water Authority.”

“EXISTING MAINS SUFFICIENT UNTIL JUNE, 1905.”

“The Company appear to suggest that they require the new 30 inch main from Wilmington to Deptford for the purpose of tiding them over the next two years, but I cannot find they say this in so many words. On the other hand, Mr. Morris, their engineer, said in the Committee Room of the House of Commons, in answer to a question put to him by Mr. Wedderburn, in explaining the object of the 30 inch main—that

“we might be called upon to supply East London”

And again two questions later, he said :—

“we are supposed to have any rate a certain amount of
“reserve supply in hand with which we might be able to assist
“other Companies, if the Local Government Board call upon
“us to do so.”

“In my opinion the new 30 inch main is not required, and will not be required, for the supply of water to the inhabitants of the Company’s district up to June, 1905.”

“On the basis of figures I have previously given, the requirements of the Kent Company in the County of London will be 16,878,000 gallons per day. At Deptford and Plumstead, both in the London District, 8,800,000 gallons per day are available.”

“Shortlands and West Wickham, after supplying their own district, have a surplus of 1,737,340 gallons per day. The capacity of the Mains from these two Pumping Stations to Deptford is 2,154,500 gallons. At Orpington the surplus will be 1,724,410 gallons and the capacity of the Mains from there to London is 2,661,000 gallons. At Southfleet, Wilmington and Crayford the surplus will be 7,943,790 gallons and the Mains from there to London can pass 8,818,500 gallons. The London area of the Company's district, therefore, in 1905 will require 8,078,000 gallons per day beyond what is supplied within such area, and as against this the existing Mains have a capacity up to 13,634,000 gallons.”

“DEPLETION, RAINFALL AND PERCOLATION.”

“The local evidence shows that streams are drying, springs are lessening in their flow or are ceasing to flow altogether, that wells have to be deepened at considerable cost, and that great loss is being sustained in consequence. I am of opinion that this is mainly due to the pumping operations of the Water Company, assisted by the pumping of cement manufacturers, paper millers and others. It may to a slight extent be due to some reduction in the amount of rainfall in the past few years but this cannot account for anything like the whole of the depletion which has been experienced. The amount pumped from the chalk in this district represents a large proportion of the total rainfall reaching the chalk, and in some years actually exceeds that amount. It is not to be wondered at therefore that water is becoming very scarce above the surface of the ground.”

“The late Mr. Symons, who devoted great attention to the matter of rainfall, has given in a statement laid before Lord Balfour's Commission, a table shewing the mean rainfall in the watershed of the

Thames above the Nore. He included in this statement the values for 8 stations in Kent for the 10 years 1880-89 as follows :—

Kent, Sevenoaks, River Hill	...	..	...	...	26.54
„ River Head Vicarage	...	...	...	...	28.37
Bickley, Highfield	...	...	...	...	26.28
Beckenham, Foxgrove	...	...	...	...	23.93
Rochester, Knight's Place	...	...	...	...	25.67
Dartford	...	...	...	...	22.00
Blackheath	...	...	...	...	24.29
Greenwich, Royal Observatory	...	...	...	...	23.94
Average					25.13

“The average rainfall at these 8 stations during the 10 years was 25.13 inches. Inasmuch, however, as Mr. Symons does not include a station on the high land to the south west of the Kent Water Company's district, I propose to add an assumed station on the high lands giving a rainfall of 36 inches. This will give a mean annual rainfall of 26.33 inches.”

“The Kent Company in their statement laid before Lord Balfour's Commission, stated that the rainfall varied from 24 inches to 36 inches in their district. There is however a large area of the district over which the average is from 22 inches to 24 inches and the highest rainfall named is limited to the extreme south-west corner. I propose therefore to take 26.33 inches as the average mean rainfall over the district for a series of years.”

“It is well understood that of the total amount of rain falling on the surface, part flows off the surface and runs into the rivers, forming floods of less or greater magnitude, part is evaporated or absorbed by vegetation, and some passes down into the soil to feed the underground reservoir. It is this last, and this last only, that is available for supplying the wells. The amount of rainfall percolating into the soil under varying conditions, has been measured in several places by constructing gauges holding soil of various kinds, and by measuring the quantity of water passing through them.”

“Percolation gauges have been in use at Nash’s Mills (Hemel Hempstead) and at Lea Bridge, in Hertfordshire, the former over 40, and the latter over 22 years. The rainfall at these places for the periods during which the gauges have been in operation has been on the average 27.44 and 25.76 inches respectively. Both gauges show the amount of percolation through three feet of soil.”

“If an average is struck between these two a result of 26.60 inches is obtained, which is slightly above what I have taken as the average in the Kent Company’s district.”

“Gauges have been in use for several years at Rothampstead, but the results are not to be relied upon, the surface of the gauges being constantly disturbed by hoeing in order to prevent the growth of vegetation. The gauges at Nash Mills and Lea Bridge approximate much nearer to the natural conditions. The quantity percolating indicated by the gauge at Nash Mills averages, over a period of 40 years, 6.60 inches per annum, and that at Lea Bridge extending over 22 years averages 6.85 inches per annum.”

“In my opinion these percolation gauges only give an approximate idea of the quantity of water percolating into the chalk or into the soil. It is practically impossible to make the soil in the gauge as compact as it is found under natural conditions. The fact that part of the ground upon which rain falls, has an impervious covering has a considerable effect in diminishing the quantity percolating; and, again, in the case of dense woods there is very little percolation over such an area. The County of Kent is well wooded, and a considerable deduction must be made for this fact. Further, there is nothing to show that if water does reach a distance of three feet below the surface, it will not be drawn up again and evaporated. The chalk has a considerable power of capillary attraction, and it is possible that in very dry seasons water may be drawn up to the surface again from a much greater depth than three feet.”

“The percolation indicated by the gauges is therefore probably considerably in excess of what really takes place.”

“That seven inches of percolation is the maximum figure to be taken is shewn by gaugings of rivers in similar districts taken at points where

the whole of the rainfall upon a catchment area of known size (except such portion as is evaporated) flows past the point where the gauging takes place."

"The River Lea yields on the average, including flood waters, a fraction over seven inches of the rainfall on the catchment area. The River Colne (another tributary of the Thames) also yields on the average seven inches including surface waters. The Thames above Teddington gives an average yield of 8.61 inches, but in the Thames basin there is a much larger proportion of impervious soil than in either the Valleys of the Lea, or the Colne, or in the Kent district, the consequence being that a large quantity of surface water flows into the Thames before it can be evaporated, and occasionally floods that river."

"I will assume, however, that on the average of years, seven inches per annum will go to the supply of the underground waters. Moreover, seven inches is the figure adopted by Lord Balfour's Commission for the average of ordinary years in this district."

"This quantity, on the basis of 110 square miles given by Mr. Morris as the area of contribution, would yield only 30.8 million gallons per day. It must be borne in mind, however, that the total amount percolating over the whole area cannot be pumped up again, especially at a comparatively few points. Mr. Morris in his evidence admits this when he states that he does not expect by wells to obtain more than three-fourths of the quantity percolating. This would work out at $22\frac{1}{2}$ millions gallons per day."

"Referring again to the results furnished by the Nash Mills and Lea Bridge percolation gauges, it will be noted that the figures previously given were averages only, and an examination of the records shews that in the years of small rainfall the amount of percolation is considerably lower than the average. Thus for single years, values below two inches have been recorded, and the total percolation shewn by the Nash Mills gauge for one year was as low as 0.09 of an inch. The average for two consecutive dry years has given an amount as low as three inches, and in one instance has been less than two inches, and the average of three consecutive dry years has been as low as $3\frac{1}{2}$ inches."

“The 18 millions gallons now being taken by the Kent Water Company represents more than four inches of percolation. It is clear therefore that there are many years in which the quantity pumped is greater than the supply of water to the chalk, and that in some cases this living upon capital extends for a period of two years and occasionally for three years in succession.”

‘EFFECTS OF PUMPING UPON RIVERS AND SPRINGS.’

‘It is perfectly obvious that pumping from the chalk must necessarily reduce the flow of the rivers and the volume of the springs, and that if the water is taken in large quantities, it must reduce the level of the line of saturation in the chalk. The immediate effect of pumping from wells where the porous stratum comes to the surface is undoubtedly felt near the well rather than at a distance, but that it has a general effect on water at a distance otherwise rising to the surface is undoubted.’

“I could give many instances of the effect of pumping from deep wells upon springs and streams, amongst which I may mention : ”

“HAILEYBURY COLLEGE WELL.”

“At Haileybury College, in Hertfordshire, there is a deep well sunk into the chalk which is particularly affected by one of the New River Company's Wells at Rye Common, situated at a distance of 1 mile 550 yards. The amount of pumping by the New River Company in the district has been increasing very rapidly during the last 10 years. The well was originally 193 feet 6 inch in depth, but in the Autumn of 1898, the water levels in the chalk had been so much lowered that the well had to be deepened a further 12 feet. This gave an adequate supply for the time being, but the pumping of the New River Company continued to increase and the quantity available in the Haileybury Well became less and less, and at last arrangements had to be entered into with the New River Company to lay a main across country and to supply the College with water. Very careful observations were made during the summer of 1898, and daily records were kept of the level of the water in Haileybury Well, with the result that when the pumping at Rye Common stopped,

as it frequently did on Sundays, the water in the Haileybury Well was found to be higher on the Monday morning following. The total lowering of the water level at this well during the period referred to was about 30 feet. This variation of the water level at a distance of one and one-third miles from the Company's well indicates that a lesser variation would take place at a much greater distance, and tends to shew that the effects of pumping from a deep well are very far reaching."

"CHADWELL SPRING."

"As another instance I might give that of the Chadwell Spring, the water of which was brought to London by Sir Hugh Middleton, in 1613. This Spring is situate in the valley of the River Lea above the line of wells belonging to the New River Company. Until the last few years this spring has given an uninterrupted supply of water for nearly 300 years. During the last 10 years the pumping by the New River Company has been gradually increasing, and during the same period the flow of the Chadwell Spring has been gradually decreasing, until, on the 26th of August, 1898, the flow of the Spring ceased for the first time in its history. The Spring did not resume its flow until November 30th. Notwithstanding the fact that the following winter rainfall of 1898-1899 was slightly above the average, and in the winter of 1899-1900 very much above the average, the Spring has ceased to flow each Autumn since that of 1898, and upon each occasion has been inoperative for a longer period as set out below, the only explanation being that the pumping from the Company's wells is the cause of the stoppage of the flow."

"CESSATION OF FLOW OF CHADWELL SPRING."

Year.		Dates.		No. of Days.
1898	...	26th August to 30th November	...	68
1899	...	24th June „ 6th „	...	132
1900	...	17th July „ 24th „	...	139
1901	...	18th June „ 28th December	...	193
1902	...	15th May to		

“When the Spring ceased to overflow in 1898 the New River Company put down pumping machinery and pumped from a sump in the basin of the spring into the New River, and further lowered the water in the Spring. There is a line of wells extending up the valley for a distance of 1,200 yards from the Spring, and soon after the pumping from the Spring commenced the level of the water in these wells commenced to sink, and did not rise again until pumping had ceased. In 1901, particularly, some weeks after the pumping commenced, an accident occurred to the pumping machinery at the Spring, or for some other reason the pumping was stopped; immediately this occurred the water level in the wells commenced to rise, and continued to rise until pumping from the Spring was resumed when it again fell. This occurred in each well observed up to the most distant, 1,200 yards up the valley, and it is clear from the variation of that well that the effect extended much beyond this distance, and could have been shewn had there been other well, in suitable places.”

“COW ROAST.”

“Another instance of water in wells and in streams being lowered by pumping operations occurs in the valley of the River Bulbourne, between Great Berkhamstead and Tring ”

“An experiment was tried under orders from the Court of Chancery in the case of Dickinson and the Grand Junction Canal Company, in the year 1849. A well was sunk by the Grand Junction Canal Company to the depth of 75 feet with bore-holes into the chalk for the supply of the summit level of the Canal. Messrs Dickinson complained that this pumping reduced the flow of the stream. The result of the first series of experiments was to shew that the flow of the stream was reduced for a considerable distance down the river, the most distant gauge affected being nearly three miles from the well. The Company then stated that this was due to the well not being puddled and the experiments ceased for a time to allow the Company to puddle the well, which they did, but further experiments were made and the results were equally conclusive.”

“Pumping from this well has taken place in late years in dry seasons with a marked effect upon the district. A number of comparatively shallow wells in the village of Aldbury, two miles up the valley, being affected. They gradually lost their water until it became necessary to seek a supply from the Chiltern Hills Water Company, and this has now been laid on. The first marked lowering of the wells occurred in the dry summer of 1891. There are a number of bore-holes in the valley of the River Bulbourne, and one of these has been under observation for some years past. In 1891 the general dryness of the season had stopped the overflow from this bore-hole, and the level of the water had sunk four inches below the top before the pumping from the Company's well had commenced, but directly the pumping commenced the water level sank rapidly, and about two months of pumping reduced the level to four feet below the top. The same thing occurred in the summer of 1894, although to a somewhat less extent.”

“The Town Farm Well at Aldbury, two miles from the Company's well, clearly indicated when the pumping was going on. The well became dry when pumping was proceeding, whereas when the Company stopped pumping the water rose about three feet, and sank again as soon as the pumping recommenced.”

“AMWELL MARSH. EXPERIMENT.”

“A good instance of the power of deep wells to affect surface springs and streams is furnished by experiments made in connection with the Royal Commission of 1893, at Amwell Marsh, Hertfordshire, on the 23rd of March, 1893, by the Assistant Commissioner and myself. Arrangements were made with the New River Company that two of their pumping stations, namely, those at Amwell Hill and Amwell Marsh, should remain at rest for some days previously. On the day in question the flow in various watercress beds and springs was carefully noted, and the pumps started. Some of the springs were dried within half-an-hour of the start, small streams declined in their flow visibly, and some entirely dried up. After six hours pumping all the small streams were dry, and every spring was dry excepting one, that being the historical Emma spring, and even this had very materially declined in its flow. The investigation, however, did not extend beyond a radius of quarter of a mile from one or other of the pumping stations.”

“BROXBOURNE SPRING.”

“In the Broxbourne Public Gardens there was a chalybeate spring which had always flowed as far back as any records can be obtained. The water rose up the shaft of a fountain and was discharged horizontally at a height of over five feet above the river level. It had never been known to fail until the Broxbourne Station of the New River Company, half a mile distant, was constructed. It then ceased to flow. Upon several occasions, when pumping at the station has stopped for a considerable period, the spring has discharged some water. Upon investigation in 1893, it was found that the spring did not begin to flow until three days after the pumps had stopped, and after 22 days cessation from pumping the spring had not attained its full strength.”

‘PUMPING BY THE KENT COMPANY ON THE HIGH LANDS AND ITS EFFECT.’

“I now proceed to consider the effect on the water levels in the chalk in the neighbourhood of the wells of pumping by the Kent Company on the high lands.”

“The Pumping Station at Orpington is in a position to do a large amount of damage. It is so situated that it is able to intercept the underground water which would otherwise reach the springs, forming the source of the River Cray.”

“I am informed that the Orpington Springs, which rise on the south-east side of the main road, were measured before the pumping station started and were found to be discharging about $3\frac{1}{2}$ millions gallons per 24 hours, and that as far as memory can go back these springs have been discharging constantly more or less water up to the time when the Orpington wells were constructed. On the 20th May last, no water was rising over the area of the springs, or to be more precise, no water was flowing from the spring head under the road into what used to be the stream. The area of the gathering ground supplying this point, appears to be about 15 square miles.”

“A percolation of 7 inches per annum might be expected to give an outflow at Orpington of about four million gallons per day. With the rainfall and percolation below the mean, the flow would naturally be proportionately less. Nothing has occurred, however, in the reduction of the rainfall, and in the consequent smaller amount of percolation, to account for the large reduction in the flow of the river.”

“On the other hand, the drying of the springs, and the reduction in the flow of the river are very easily accounted for by the pumping. If, out of a percolation of seven inches—which on 15 square miles gives four million gallons a day, and less in dryer seasons—the Orpington Pumping Station raises $2\frac{1}{2}$ million gallons per day, the whole thing is accounted for; and when it is borne in mind that in dry seasons the percolation is very much *less* than seven inches, it is conceivable that at times there would be hardly any flow in the river near Orpington.”

“I have already said that there is no decline in the rainfall sufficient to account for the decline in the flow of the rivers. For the ten years 1881-1891 the yearly rainfall at Greenwich has averaged about one inch below the mean of the last 40 years, and during the last 10 years, 1891 to 1901, the annual rainfall has been about two inches below the mean. It must be remembered, however, that it is the winter rainfall that produces the amount of percolation feeding the springs, and it appears that during the last 10 years the winter rainfall has been slightly above the mean.”

“I think it is clear that the wells at Shortlands and West Wickham have affected in like manner the River Ravensbourne.”

“Should the House of Lords pass the present Bill, it is very probable that the well at Westerham Hill will dry the springs at the head of the River Darent and will accentuate the existing shortage in the Cray Valley.”

“This well is situate at the head of the valleys of the Rivers Cray and Darent and is on the watershed between those two rivers. It is therefore in a position well calculated to deplete the springs in the upper parts of both rivers.”

“AS TO PUMPING FOR THE SUPPLY OF A LOCALITY
FROM A DISTANCE.”

“The following quotation from a speech by Mr. Joseph Chamberlain in the House of Commons on the Wolverhampton Corporation Water Bill, 1901, is, it seems to me, pertinent to the present issue” :—

“What is the principle which I lay down in regard to Water supply which must come from a distance? It is that the localities which are affected should not be injured, that all that the central bodies should be allowed to take is the surplus and nothing more, and that it shall be bound to supply to the localities first all the water in which they stand in need, to which they have a legitimate claim, and at a reasonable price first, and only the surplus should be the property of the authority seeking this power. That I believe to be a perfectly fair principle to lay down.”

“I think this principle may very properly be applied to the Kent Water Company.”

“The Kent Company must have water for the supply of their district, but they should be required to take it in the way least calculated to do damage to any part.”

“I consider that pumping from the high lands is more harmful to the wells and springs than when water is taken from land at a lower level near the point of overflow of the chalk reservoir.”

“More than three-quarters of the population supplied by the Company reside within the County of London, and nine-tenths of the whole population is situated in the northern part of their district bordering the River Thames. This latter district is less than one-third of the Company's total area of supply, but, as I shall show, sufficient water could be obtained within it to supply that part of the district. The Company, however, instead of taking water where the bulk of their population resides, have sunk wells out in the country to the south at a distance from the people who want the water, and in places where the wells cause a maximum of damage to the rivers, springs and local wells of the district. This also necessitates long lengths of large mains to make the water available for consumers.”

“WATER AVAILABLE NEAR THE RIVER THAMES.”

“For the reasons I have given it is very desirable that the Company should get their water from the low lands in the north rather than from the high lands in the south of their district.”

“Mr. Barlow stated before the Royal Commission on Water Supply, 1868, that 60,000,000 gallons a day might be obtained by intercepting water flowing into the River Thames between Lewisham and Gravesend. Professor Ansted agreed with this view.”

“Again, before the Royal Commission of 1893, Mr. Topley, an eminent geologist, stated that there was an enormous amount of water flowing into the Thames over and above what is pumped by the Kent Water Works. This view was corroborated before the same Commission by Professor Boyd-Dawkins, and Mr. C. E. De Rance, the latter appearing on behalf of the Kent Water Company.”

“I think it may therefore be taken for granted that a very large quantity of water may be obtained from lands in the neighbourhood of the River Thames. If the Company were to intercept this water before it gets into the Thames, instead of taking a supply from the high lands less harm would be done to the springs on the high lands which go to feed the rivers and wells.”

“By confining their heavy pumping to a comparatively limited area as at present in the vicinity of Dartford, that district is unduly depleted, whereas by extending the line of pumping stations from Deptford to Gravesend the overflow would be intercepted at more or less regular intervals and no one area would be excessively drained.”

“PROPOSED RESTRICTIONS ON THE COMPANY'S PUMPING.”

“If the Committee of the House of Lords consider that the Kent Water Company should be allowed to make use of the wells they have recently sunk at Dartford, Crayford and at Darenth, and for which they ask money to enable them to be completed, I think a clause should be put forward prohibiting the Company from making use of any of their wells

on the high lands south of the London, Chatham and Dover Railway, except in cases of emergency or at the most for the supply of the local districts."

"If the present works are completed the Company will have at their command in the north part of their district enough wells to supply water for the whole of the population of the district up to 1905 or later without drawing upon the wells in the high lands, as follows"—

Situation.	No. of Wells.		Yield of Wells in gallons per day.		
Deptford ...	...	3	...	...	8,000,000
Plumstead ...	...	1	...	...	800,000
Crayford ...	...	3	...	...	3,500,000
Shortlands ...	...	2	...	...	2,250,000
Wilmington	...	2	...	...	6,000,000
Southfleet ...	...	1	...	...	1,000,000
NEW WELLS.					
Dartford ...	...	1	...	...	1,000,000
Crayford (Wansunt) ..		1	...	...	2,000,000
Darenth ...	...	1	...	...	2,000,000
Total ...					<u>26,550,000</u>

"The total quantity required up to June, 1905, has been shewn to be only 20 or on the most liberal basis 22 million gallons per day, and I therefore think that the Committee should be asked to put upon the Company limitations, as follows, excepting when specially released by the Local Government Board in cases of absolute necessity"—

"AT SHORTLANDS AND WEST WICKHAM.—The Company shall not pump more than sufficient to supply Bromley, Chislehurst, and neighbourhood."

"AT ORPINGTON.—The Company shall not pump at all unless the Knockholt reservoir cannot be supplied in any other way, and in no case for the supply of the district north of the London, Chatham and Dover Railway (Main Line)."

"AT WESTERHAM HILL.—The well shall only be used for the supply of the district south-west of Knockholt."

"I am, Gentlemen,

"Yours faithfully,

"URBAN A. SMITH, C.E."

A great deal of evidence was collected for the purpose of the opposition, amongst others Mr. H. E. Gilman, who owns land on the River Darenth, was able, from his own personal observations, to prove a very important point. He had on his estate a trout stream fed by a spring which completely dried up when a pumping station was started in the district. He noticed on a particular occasion in September, 1898, that water began to well up in the bed of the spring which had been dry for some time, and shortly afterwards the water disappeared again. He found afterwards that the appearance of the water corresponded exactly with the time that there was a breakdown at the pumping station, and its disappearance with the resumption of pumping.

At the meeting at Cannon Street Hotel, Colonel English mentioned that a spring existed on his land within 150 yards of the new pumping station at Darenth, but that when trial pumping was started the river ran into the spring instead of the spring into the river. A similar instance was brought to our notice in Hertfordshire by Mr. Lewis Evans, which had been traced directly to the operations of a Water Company.

Valuable evidence was afforded by Mr. Alexander Dickson during his cross-examination by Lord Robert Cecil. His evidence throws light on the exhaustion of the chalk basin, and shows that one of the large wells of the Kent Water Company does not now yield nearly so much water as it did formerly.

It is only fair to give Mr. Alexander Dickson's evidence verbatim from the printed Minutes of Evidence before the House of Lords Committee, (Questions 1420 to 1429), in order that those who read it can form their own deductions.

“ 1420. You were good enough to instruct my learned friend, Mr. Lewis Coward, to say yesterday that you were now drawing from the Orpington Well one million gallons less than you were doing. Yes, that is right.

1421. Why is that? One reason is that the use of that pumping station in the Westerham Hill Park Estate for the supply along the ridge has lightened the burden which previously existed on the Orpington Pumping Station for supplying up there.

1422. You told me yesterday that you were using your wells to their utmost capacity, and that you had no margin in any of your wells. Is that true? I do not know that I used that expression generally, but I did with regard to the particular instance you were putting about the demand.

1423. I was putting Orpington. Now, have you any margin at Orpington or not? At the present time I should say the margin at Orpington is very small indeed.

1424. In fact you are practically pumping as much as the well will yield? Yes, in its present arrangement.

1425. May I take it that the well yields now one million gallons a day less than it did a few years ago? We do not think it desirable to pump beyond.

1426. Answer the question. Is it a fact that the well yields now one million gallons a day less than it did a few years ago? It is a fact that a million gallons less per diem is being pumped from it.

1427.—You are now pumping as much as it can give. I suppose a few years ago you were also pumping as much as it would give? It would not be desirable to carry the pumping so far as to thoroughly exhaust the flow of water into the well.

1428.—That is equally true of a few years ago, and this time I suppose you were always acting under the advice of your Engineers? Yes. Of course that is equally true in all seasons of extreme drought.

1429.—We have not seen your Engineer, and have not been able to ask him."

Mr. Strachan, one of the engineers, who gave evidence before the Committee on behalf of the Association, pointed out that water is often taken by Water Companies from such points as are most calculated to effect the interests of the district; but he furthermore showed, and the point has been emphasized more than once before the Royal Commissioners on Metropolitan Water Supply, that water can be taken at or near the mouth of a stream without serious consequences, but when water is taken

in the vicinity of springs which go to feed the streams at or near their source, much damage is likely to result. It seems probable therefore that we have not only to consider the amount of water taken over a given area as affecting the question, but there must be also taken into consideration whether or not the water is taken from a spot least calculated to injure the district.

We are indebted to the Secretary of the Institution of Civil Engineers for the following papers read before the Institution bearing on the subject:

- 1.—The Periodical Alterations and Progressive Permanent Depression of the Chalk Water Level under London. Vol. 9. 1850. Rev. James Charles Clutterbuck, M.A.
- 2.—Rainfall and Evaporation. Vol. 45. Part III. 1876. Symons, Greaves & Evans.
- 3.—The Chalk Water System. Vol. 47. Part I. 1877. Joseph Lucas.
- 4.—Report of the Committee on the Circulation of the Underground Waters see Report of the British Association. 1895. p. 393.
- 5.—Underground Water Levels of the South Downs between Eastbourne and the River Cuckmere. Vol. 142. Part IV. 1900. H. M. Whitley.

There are several others of equal importance but unfortunately some of them are out of print. It will be noticed that one publication cited above dates back over 50 years. There were many important points brought out in the discussion which followed on these papers, which want of space compels us to omit here, but which become particularly interesting and significant in the light of recent disclosures.

The following quotation from the first mentioned work bears on the subject of the depression of the water level in the London Basin.

“Having shown the natural, or normal condition of the ‘chalk water-level,’ it remains to consider the actual and artificial conditions, in which it is found at present, under, or in the immediate neighbourhood of London. Formerly the level was regulated and fixed, by its natural vent, or outfall, in the Thames below London Bridge; now it is unnaturally depressed by the discharge of water from ‘artesioid’ wells, and not only is

the level in one well lowered by the pumping in an adjacent one, but a general and permanent depression, amounting in some localities to 50 feet, or 60 feet below Trinity high-water mark, may be distinctly traced. A calculation based upon the ascertained height at which the water stood every Monday morning, during the years 1841 to 1848 inclusive, in a well in London, in which the level is seldom disturbed, shows, first, alternations of level, coincident with the periodical exhaustion of the chalk stratum, by natural drainage and its replenishment by rain water, percolating the surface of the chalk, where it is not covered by the London, or plastic clays; and secondly, a permanent progressive depression of the level in the aggregate."

At the conclusion Mr. Clutterbuck summed up as follows:—

"Though there is still much to be learned in this great question, the following facts are clearly established; that the rapidity of the exhaustion from 'artesioid' wells, in and about London, greatly exceeds the rapidity of the supply; that the amount of this defalcation is marked by the extension of a progressive permanent depression of the 'chalk-water level'; that this depression may, at certain points, be measured; and that, every year, the supply of water from the chalk stratum becomes more precarious, and less to be depended upon, even should there be no addition to the number of 'artesioid' wells in the metropolis."

In the discussion which followed on the reading of his paper Mr. Clutterbuck remarked—

"That a great and gradual depression of the water level under London had occurred could not be denied; and he believed that it was produced by the amount of pumping from the chalk stratum, the supply from which was not equal to the demand.

There was really a progressive permanent depression; progressive, as could be proved, and permanent so long as the present demand continued."

Mr. Dickinson, during the discussion, remarked that—

“Taking the average for this period, the quantity of rain that fell was nearly 26 inches per annum, of which rather more than three-eighths passed through to the springs; it appeared that summer rains did not contribute materially to the permanent supply of rivers He deprecated all undertakings, in which the water for the supply of London was proposed to be obtained by boring, because he thought it would be attended with disastrous results, and might, by the exhaustion of the strata, ultimately have the effect of drying up wells and rivers, so as to ruin whole districts of country.”

In the course of his reply the Rev. Mr. Clutterbuck said—

“the general question of the supply of water to London, was one of such vast importance that it was in the highest degree essential to possess accurate and authentic geological information before commencing such great works as those of the drainage and water supply now in contemplation for the metropolis, in order that they might be executed on a sound and certain basis.”

and concluded by stating—

“that the practical conclusions to be drawn from the observations recorded in his several papers were:—That the natural drainage and replenishment of the chalk stratum might be accounted for by observing the alternation of level in various localities and at different seasons. That any large quantity of water abstracted from the chalk stratum, at any given point, caused a depression of level around the point of such abstraction. That in the upper districts any such abstraction of water would interfere with and diminish the supply of the streams by which the drainage of the district was regulated. And, lastly, that the depression, of the level under London, by pumping from ‘artesioid’ wells, had proved that the rapidity of the demand already exceeded that of the supply, and that any attempt to draw a large additional quantity for public use would be attended with disastrous consequences.”

In giving an instance of measurements made with percolation gauges, Mr. Greaves, in his paper states that—

“The percolation through ordinary ground has been 26.57 per cent. of the rainfall in twenty-two years, and the evaporation 73.42 per cent. of the rainfall. The evaporation from a surface of water has been 77.77 per cent. of the rainfall.”

And as showing the time which elapses before the rainfall has any marked influence on the springs, he informs us that—

“It is possible that percolation, or the absence of it, at one period may have an influence extending over more than twelve months, but it is not habitually so. A wet winter will give abundant springs in the following autumn; but if that is followed by a dry winter, the latter will obliterate the effect of the previous wet winter.

“Predictive meteorology is far removed from practical engineering, nevertheless, the percolation gauge gives a most certain scale of the future state of springs. The delivery flow of water from springs in the autumn, and consequently the fulness of rivers so fed, is maintained by the rain fall of the previous winter. Summer percolation is nil; and rivers, except as influenced by the rain of the time being will be short indeed, in September and October, if the percolation of rain has not been considerable in the previous December, January or February. Intermittent springs are developed according to the previous percolation, and not simply according to the rainfall, with which they sometimes do not agree at all. Heavy rains in summer may afford no percolation, and a whole year may be considered wet and yet not be one in which springs are fed. The quantity of water evaporated gives a scale of the capacity of the atmosphere for evaporation, and consequently of the degree of its humidity.”

Mr. Evans (now Sir John Evan) draws attention to an important factor which has since been emphasized by Mr. Urban Smith in his evidence—

“It was found that what might be called the meteoric year, the year of percolation, consisted of a summer half, during which hardly any percolation occurred and a winter half, during which

nearly the whole of the percolation took place; and that if the year was made to end on the 31st of December a false idea was obtained as to the amount of percolation. It was better to adopt the principle followed by Mr. Dickinson, and by himself in the tables he communicated to the Institution fifteen years ago, of making the rainfall and the percolation year terminate on the 31st of March; it gave a better insight into what was really going on, and rendered it more easy to predict the results during the ensuing season."

Dr. Gilbert gives details of the gauges which he and Mr. Lawes had constructed for the purpose of ascertaining the amount of percolation—

"The area of each gauge was one-thousandth of an acre. They had one such gauge with 20 inches, one with 40 inches, and one with 60 inches depth of soil; so that they were able to answer some of the questions with regard to capillary action to which reference had been made. Of previous determinations Dr. Dalton's had indicated that 25 per cent. of the rain percolated; those of Mr. Dickinson showed up to a certain date 42.5 per cent.; those of M. Maurice at Geneva, 39 per cent.; those of M. Gasparin, in the South of France 20 per cent.; those of M. Risler, near Geneva, 30 per cent.; or an average of 31.3 per cent. under different conditions in five different localities. Mr. Greaves gave 28 per cent. For a period of five years Mr. Lawes and himself found 36.8 per cent. of the rainfall percolating through 20 inches, 36 per cent. through 40 inches, and 28.6 per cent. through 60 inches. They had a natural soil, a sub soil with its natural consolidation; whereas Mr. Greaves's was an artificial soil."

The question has been debated whether the chalk itself allows the water to pass, or whether it passes by means of cracks or fissures, and upon this point Mr. Baldwin Latham has remarked that—

"Mr. F. Braithwaite, M. Inst., C.E., and Professor Prestwich had given their opinion, that there was little percolation through the chalk itself, that filtration was slow, that the water moved through the cracks, clefts and fissures, and through or under layers of flints, and that only the free water of the chalk was available in wells for the purpose of water supply."

"The appearance of other bournes rather pointed to the fact that the Upper Chalk was more fissured and broken up than the Lower Chalk, and that rain moved more rapidly through the Upper Chalk."

Mr. Rogers Field considered that—

"Messrs. Lawes and Gilbert had adopted the only right mode, that of taking some of the ground in its natural state of consolidation, then underpinning and building round it."

Mr. Greaves makes some useful observations, which, if proved to be correct, would make the calculations for the flow of streams a comparatively simple one.

"He wished Mr. Symon's Paper had given the proportion between the flood water of a river, the ordinary discharge of a river, and the rainfall. As he had not done so, he would hazard the following:—That the ordinary discharge of a river was supplied by one-sixth of the rainfall, and of a river when in flood by one-tenth; and that the sum of those two was nearly the same as a result given by the ground-percolation gauge."

Professor Ansted stated that he was equally

"certain that exhaustive pumping gradually drained a large district below the natural and ordinary level of the water, both above and under ground, in that district."

Sir John Evans in his paper said the Winter half-year is considered to commence on the 1st of October, and the Summer half-year on the 1st of April. From this it is obvious that the amount of percolation is more dependant upon the time at which the rain falls and the manner in which it is distributed than on its actual amount, as results show that nearly all the percolation takes place during the Winter and very little during the Summer.

Mr. Urban A. Smith's remarks are therefore in confirmation of Sir John Evan's researches.

The following is an abstract from Sir John Evans' Presidential Address to the Geological Society, delivered in 1876, in which he refers to a proposal contained in the sixth report of the 1868 Commission on the

“Pollution of Rivers” that London and its suburbs should be supplied exclusively with water to be pumped from the chalk and lower green sand.

“That it will come within the province of the Geologist to point out what will be the effect of its abstraction upon the districts, where it now exists, in sufficient abundance to flow into the streams, how what are now fertile and even irrigated meadows will be converted into arid wastes, how watercress beds, now of fabulous value, will be brought to the resemblance of newly mended turnpike roads. How, in such a district all existing wells will be dried, many of them already some hundreds of feet in depth, and the mill streams disappear. And these results will, if the scheme were carried out, not be confined to some single spot, but would extend over hundreds of square miles.

This prophecy has in a large measure been fulfilled :—

Mr. Clayton Beadle in his Paper before the Sanitary Congress at Manchester, in 1902, in which he gives the history of the work of the Association, first as the Kent Water Preservation Association, and subsequently as the Underground Water Preservation Association; gives a summary of percolation figures arrived at by different observers abstracted from among the foregoing publications.

Reference						per cent.
2	Mr. Greaves (Ordinary soil) 22 years ...	...	...	...	...	26.57
2	Mr. Greaves Estimated Average for Home Counties Referred to by Gilbert ...	...	...	...	...	28.0
2	Dr. Dalton, 1796-1798 ...	...	...	...	...	25.0
2	Mr. Dickinson, 1836-1843 ...	...	...	...	...	42.5
2	M. Maurice, Geneva, 1796-1797 Referred to ...	...	...	...	...	39.0
2	M. Gasparin, Orange, S. of France, 1821-1822, by Gilbert ...	...	...	...	...	20.0
2	M. Risler, Caleves, near Nyon, Switzerland, 1867-1868 ...	...	...	...	...	30.0
2	Lawes & Gilbert, through 20 in. soil 1870-1875	...	...	...	...	36.8
2	“ “ “ 40 “ “	“	“	“	“	36.0
2	“ “ “ 60 “ “	“	“	“	“	28.6

Reference.	Per Cent.
3 Mr. Longridge, 10,500 acres, period 10 years ...	36.5
„ „ 125,000 acres	27.55
„ „ „ „	33.0
Sir John Evans, $\frac{3}{8}$ in.	37.5
Mr. Beadle's calculated average of above	
14 figures	31.93
Sir J. H. Gilbert's average for 5 observers ...	31.3
Mr. Longridge's average of 3 „ ...	32.35
Messrs. Lawes & Gilbert	33.8

Mr. Clayton Beadle's calculations and arguments at the Sanitary Congress, and in reply to certain statements made by one of the directors of the Kent Water Company, as to available supplies to certain water sheds and the possible loss to underground waters due to deficiency of rainfall of recent years, were made on the assumption that 40 per cent. percolates. Although there is considerable divergence between individual observations, the averages of the different series which include every form of percolation gauge, large and small, run each other close and would indicate that about 32 per cent. is an average figure; it would appear, therefore, that in adopting 40 per cent. as the figures for calculation. Mr. Beadle has erred on the side of caution as far as strengthening his argument is concerned.

It will be as well to notice that the results obtained by Dalton, Dickinson, Evans & Greaves, were obtained by means of gauges of one square yard in area and with made up soil, and those of Lawes and Gilbert were done with gauges of one thousandth of an acre in area and without disturbing the natural soil. Those calculated by Mr. Longridge were arrived at by taking the amount of pumping over a given area of land from which water could not escape. The average results on a large area approximate fairly closely to those made with gauges—say one yard in a area—it would appear that the results from the smaller gauges are to be relied upon.

Mr. Joseph Lucas in his paper, speaking of the way the water is distributed in the chalk, states that:—

“ The water in the chalk nowhere exists as a voluminous mass; each little stream is under the control of the fissure that

contains it. Taking the chalk as a whole, the fissures vary in size from a pin's head to a cavern large enough to contain a man, and the feeders range from the minutest jets to considerable streams. Wells in the lower chalk are more readily exhausted, as, from the moment at which the water-line is lowered by pumping, an inverted cone is formed, and the gross capacity of the fissures in this cone would presumably be greater in the upper than in the lower chalk."

The Rev. Mr. Clutterbuck in the discussion on the paper stated that:—

"There was far less water to be obtained from the lower than from the upper chalk. That would act in some measure as a warning to those who had ventured to assert that the water in the chalk was inexhaustible."

Professor Ansted confirmed Mr. Clutterbuck in his opinion:—

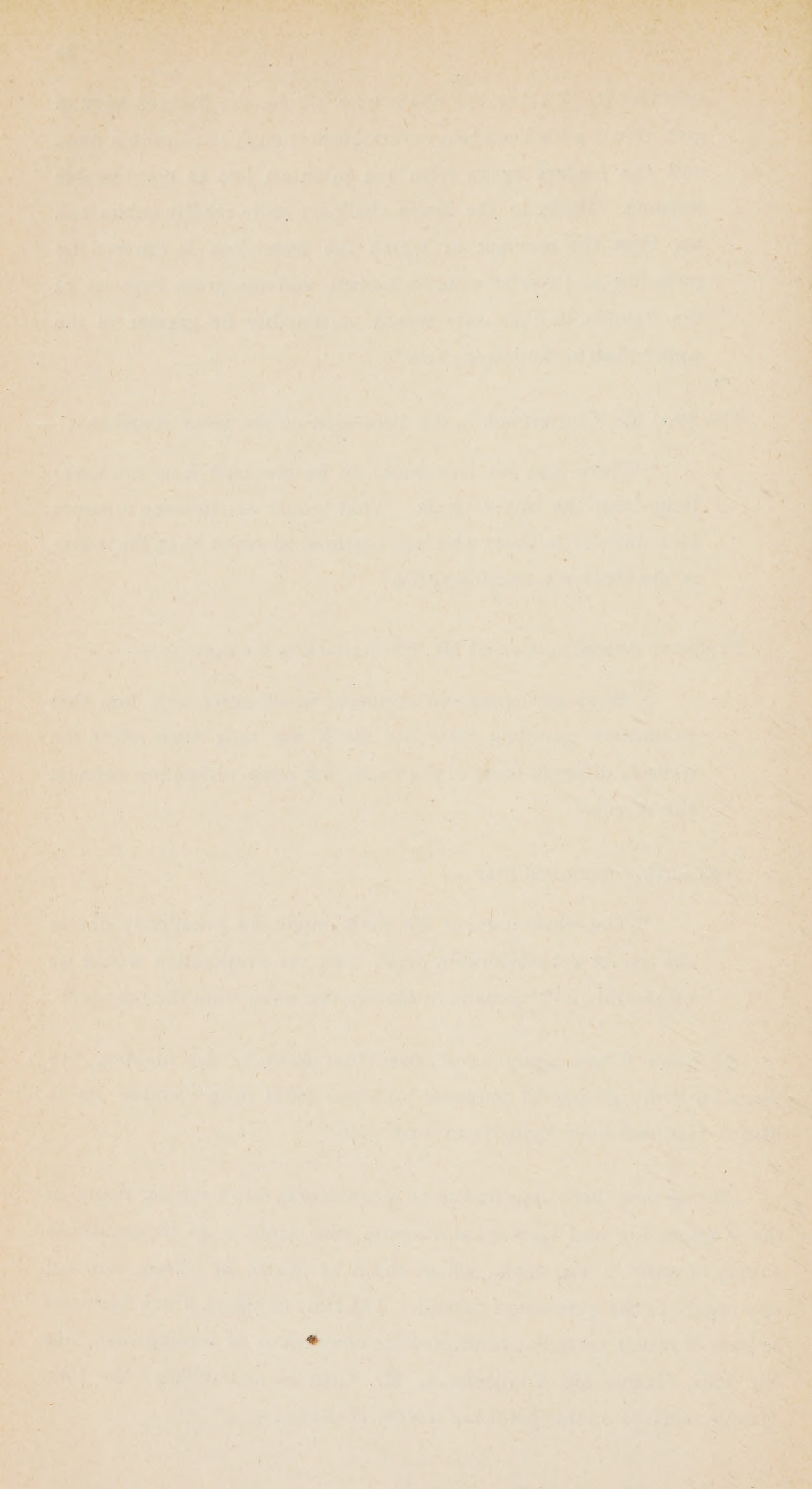
"Many geologists and engineers would agree with him that exhaustive pumping from the chalk not only must affect the wells in different parts of the chalk, but must ultimately exhaust the supply."

And further remarked that:—

"The whole mass of the chalk might be practically dry at the top for a considerable depth, and yet evaporation would go on steadily and continue to remove the water from the bottom."

Sir John Evans again emphasized the necessity for dividing the years for hydro geological purposes into two parts from October 1st to March 31st, and from April 1st to Sept. 30th.

At one time there appeared to be a conviction, even among many of the Engineering and Geological Experts, that there is an inexhaustible supply of water in the chalk, which could be drawn *ad libitum*, without any regard to the question of rainfall. The state of affairs which has come to pass of recent years has confirmed the convictions of leading men, like Sir John Evans, Mr. Clutterbuck, Mr. Greaves and others. Sir John Evans' remarks on this point are worthy of notice:—



“ With reference to the general question as to the amount of water derivable from the chalk, there could be little doubt that it was entirely dependent upon the depth of rain absorbed. One might for a certain length of time draw from the subterranean reservoir which existed, and imagine that one was getting a boundless supply, but the day must come when the underground reservoir would be exhausted, and when one would have to depend upon the amount of rain finding its way through the surface into the lower depths.”

As regards the depth of gauge, Mr. Latham remarks:—

“ A few months ago a discussion took place at the Institution, when Dr. Gilbert put in a number of records which showed that with deeper gauges the amount of percolation was considerably less than had been found with the shallow gauges.”

Mr. W. Easton makes what would appear now to be a very simple statement, but one which was strongly opposed in former years. In speaking of the chalk, he says—

“ If it were a sponge, the absorption, as well as the evaporation, would go on ; and it came back to the point that the measure of the amount of water to be got out of the chalk was the amount which was absorbed into it.”

Mr. Longridge who appears to have taken rather a different view of the subject of percolation to the majority of those who have studied the subject, made a series of observations extending over an area of upwards of 10,000 acres, (the results of which are referred to in Mr. Beadle's paper above cited) shewed what circumstances are likely to affect the question of percolation.

“ The ratio of evaporation to percolation depended on a great variety of circumstances, to wit, the nature of the surface and subsoil, the nature and growth of the vegetation, the prevailing wind, the electrical condition of the atmosphere, the mean annual temperature, and the combined effect of maximum temperature on the movement of the atmosphere. Moreover, it is an established fact that earth highly charged with water gave rise to rapid evaporation, but as it became drier it retained

the moisture with great force. Then again, the depth to which water would penetrate subsoil depended greatly on the rate at which it fell; for instance, it was observed on one occasion that in the month of June, in the Bourbonnois, a rainfall of 3.02 inches in eighty-four minutes only penetrated into the soil to a depth of two inches, whilst a fine rain in the month of July, which gave only a depth of 1.04 inch in seven hours, penetrated the same soil to a depth of 4.4 inches."

In a paper on "Maps showing the area of chalk available for Water Supply in the London Basin" by Mr. W. Whitaker, B.A., F.R.S., F.G.S., Ass., Inst., C.E., read before the Sanitary Congress at Portsmouth, in 1892, Mr. Whitaker discusses the question of water fluctuation from a Geologists point of view. We give here quotations.

"It should be understood, therefore, that even over the area colored as chalk there may be spots where rain cannot pass at once into that rock. The basal part of the chalk, too, is mostly somewhat clayey."

As regards chalk covered by permeable beds, he remarks:

"In many cases such tracts allow the access of surface water to the chalk about equally with tracts of bare chalk; but in places where there is a fair thickness of permeable beds, some delay would occur in the water getting into the chalk, and the supply might suffer slight loss. Moreover, there is sometimes, of course, a possibility of the presence in the permeable beds of unexpected masses of a less pervious character, which would have a like effect."

And with regard to chalk protected by impermeable beds:

"We now come to the tracts which are unprofitable, or mostly so, as regards contributing to the store of water in the chalk, though even here a gleam of light breaks through the darkness. In those parts, colored grey, there is, somewhere above the chalk, an impermeable bed that is enough to keep water from the surface above from sinking into the chalk. This impermeable bed need not be at the surface, nor need it rest directly on the chalk; it may come between permeable beds, but the effect will be the same."

In the discussion which followed on the paper, Mr. Henry Law, M. Inst., C.E., remarked that :

“ Mr. Whitaker had told them of the circumstances which affected the entry of water into the chalk, but there was another important question which affected the water supply—its escape from the chalk. They might trace along the seashore in many parts, and in the Valley of the Thames, enormous volumes of chalk water running to waste. In an investigation he carried on for two years in connection with the Metropolitan Board of Works, (their object being to try and obtain a supply of water from the chalk), they found chalk water escaping into the bed of the river in the neighbourhood of Brentford, at the mean level with the tide. At Erith, too, they might see it escaping. The bed of the Thames from Vauxhall to Deptford was clay, which prevented the escape of the water, but at Erith they found water from the chalk which had fallen from higher levels now escaping into the river. He thought that if they sank deep wells and pumped they would lower the level of the water, and save a great deal which at present escaped.”

Dr. J. Groves of Carisbroke in speaking in the discussion gives an instance of pumping affecting local interests.

“ It was thought possible in one instance he knew to supply a town of 10,000 or 12,000 inhabitants with water from a country district four miles off, and the landlord there sold his water both surface and underground to the Corporation, who sunk a deep well and pumped from the greensand. The result was, that they deprived all persons in the neighbourhood for a quarter of a mile round of their water supply, and those people had now been for five or six years without water.”

Dr. A. Newsholme, Brighton, asked :

“ If Mr. Whitaker had seen certain articles that had appeared in the British Medical Journal dealing with the water supply of London, in which the writer stated that the water from the chalk was diminishing, the landscape was altering, the tree growth was less vigorous, while the level of the water in the

wells was being reduced? Of course if that was correct, it meant that London would have to go for a water supply to a greater distance."

Mr. Whitaker, in reply, said:

"In some places near the sea they might sink wells and get good water, in others they could not do anything of the sort. They might sink wells in some districts a mile away from the sea and pump up salt water. There were parts of the Essex Coast where the majority of the wells gave more or less salt water, and there were cases in the neighbourhood of London, comparatively near the banks of the Thames, where wells yielded sa't water, although not far off there might be fresh water springs rising from the chalk."

"As regards the question of supplies: *If they had two pumps working and the larger pump took all the water, it was right it should do so, provided proper arrangements were made for supplying those who had been using the smaller pump.* When a town-supply was being established in a district, arrangements ought to be made by the people of that district to protect their own interests. No big town should be allowed to go into a c untry district and take the water without giving compensation for it, say, by supplying the people with water at a reasonable rate"

The italics in all cases in quoting Mr. Whitaker are our own. Note that in the above remarks, and in the following, Mr. Whitaker advances the general principle for which the Association are fighting.

"With respect to the case of Ryde, mentioned by Dr. Groves, *the authorities ought to have offered a supply in place of that which they took away.*"

The following remarks show that even ten years ago Mr. Whitaker was apprehensive of the disastrous consequences of excessive pumping:

"As to the alteration in the face of the country, he was not prepared to say that the taking of water from any chalk spring did not cause a change, but the face of the earth was always changing, though they they would want 'a double million

magnifying glass' to see it, in such infinitesimal proportions was the change being affected. *As to altering the water-level there was no doubt about it. If they took water at one spot, they must necessarily pull down the water level all round unless more went in.* Then as to the question of the limit of water supply to London from the chalk being reached, he should say that the limit had not been reached or anything like it except in the central parts of municipal London. *In some places no doubt the limit of supply, without causing disastrous consequences, was near, but it was hard to say when it would be reached.* Then as to the question whether it would affect the supplies from the South Downs; certainly not, that track was wholly away from the London Basin, but it would probably affect the springs and local supplies in the London Basin. There was a large amount of water in the chalk, and in places a large quantity running to waste which might be taken without disadvantage to anyone."

As regards the mode of abstracting water without affecting streams, Mr. Symons states that

"He fully agreed with Mr. Easton, that in districts where there was a probability of the fissures discharging towards the sea, the true plan was to run an adit or tunnel to intercept these water-courses."

This mode of abstraction if it could be carried out on a large scale for the benefit of the Metropolis might be one way out of the present difficulty.

Mr. Bramwell appears to have had the same scheme in his mind, for he says

"Near the seashore where underground rivers existed, running down towards the sea, a ready way of getting water was to make an adit parallel to the sea, so as to intercept the subterranean channels one after another."

Mr. Greaves observed that

"It was useless to propound that there was no water in the chalk, or that a vast store of water existed, from which millions of gallons might be drawn. Many wells and bores had

been failures, though the facts they certified were more instructive than those that had been successful. The failures were not so well reported as the successful ones, and were often not reported at all."

As bearing on the subject of the distribution of water in the chalk the following remarks of Mr. Greaves are worthy of notice.

"The late Mr. Morris was of opinion that the district occupied by the Kent Water Works had many crevices, and that if a well sunk after the best prospects and judgment failed to prick a source, still that a source could at no great distance be reached by lateral heading. It was at least so found in the Kent district, where on one occasion the miners had to beat a hasty retreat, leaving all their tools behind them in one of the wells there sunk, and from which a heading of some length had been extended."

Mr. Baldwin Latham, a well-known Civil Engineer and authority, in giving evidence before the Royal Commission on Metropolitan Water Supply, 1893, stated:—

Q. 7598. "If compensation were given to the Mills there is no doubt that the streams immediately round London would supply themselves 250,000,000 gallons a day of water. That is the Darent and the Cray, and the various streams in the neighbourhood of London would furnish that large supply of water. The river Darent is an extremely copious stream, and the Cray is also a copious stream.

He furthermore gives in the appendix a statement showing the number water-wheels and horse power at once available from these streams. If these figures are correct it will at once be seen that the loss of these two streams alone, if capitalised as far only as power is concerned would be equal to £356,100, and this is apart from loss to riparian owners who enjoyed the fishing rights and the loss and damage sustained due to the lowering of permanent levels through the abstraction of underground water.

Abstraction from Mr. Baldwin's figures given in Appendix referred above.

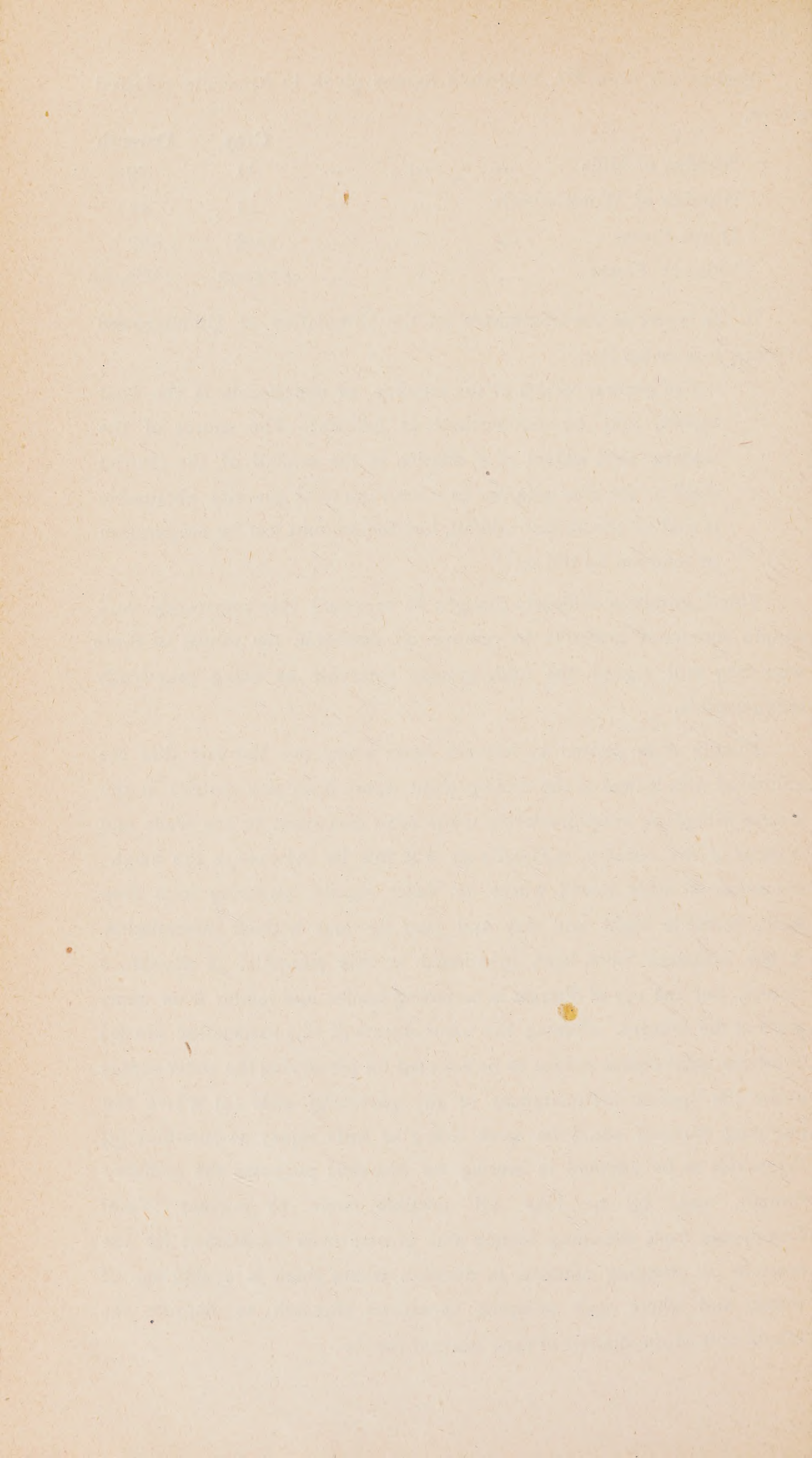
				Cray	Darent
Number of Mills	...	...	...	11	29
Number of Water-wheels		...	...	13	42
Horse Power ...	...	...	...	139½	467
Value of Power	...	...	...	£73,050	£283,050

In the report of the Committee on the Circulation of Underground Waters, it is stated that

“The general results of the enquiry, of which this is the final report, may be summarized as follows:—The source of the underground waters of a district is the rainfall of the district itself or the area adjacent to it, and the total quantity obtainable is that of the annual rainfall, less the amount lost by evaporation or retained by the soil.”

This Committee evidently thought fit to record this apparently very simple statement, probably to remove all doubts in the minds of those who may still regard the underground reservoir as being practically inexhaustible.

Finally it is desired to impress upon every one the fact that the unlimited withdrawal of the underground water from any district in the United Kingdom, must inevitably prove most disastrous to the wells and streams of the country, especially so will this be the case in the neighbourhood of large towns where for water supply, pumping from deep wells proceeds night and day and year by year without intermission. A few instances have been mentioned in this pamphlet of disastrous results, but the cry of distress is becoming louder and louder from many parts of the country. Among the chief objects of this association are (1) to advise what course is best to be adopted for preserving the water supply under the special circumstances of any particular case (2) where the pumping stations could be sunk doing as little injury as possible; (3) the course to be adopted in storing for domestic purposes the ordinary rainfall, and; (4) to take all possible steps to prevent Water Companies from obtaining money and powers from Parliament for the erection of pumping stations in districts where there is a shortage of water, and where such pumping operations threaten to deprive the inhabitants of the district of their natural supply.



APPENDIX I.

*The following is a List of Members of the Under-
ground Water Preservative Association, showing their
Subscriptions or Donations,*

	Subscriptions. or Donation.		
Avebury Lord, High Elms, Farnborough, Kent ...	1	1	0
Arnold & Foster, Ltd., Eynsford Paper Mills, Kent	2	2	0
Allnutt, H. & Son, Tovil, Maidstone	2	2	0
Ayers, A., The Nurseries, Clement Street, Swanley	1	1	0
Association of Portland Cement Manufacturers ...	1	1	0
Alliott, A. J., The Vine, Sevenoaks	1	1	0
Bligh, Hon. & Rev. E. V., Stowford House, Ivy Bridge			
Badcock, T. W., East Court, Detling, Maidstone	1	1	0
Best, M., Park House, Boxley, Maidstone ...	1	1	0
Batchelor, J. & Son, Ford Mill, Little Chart, Ashford			
Beadle, Charles J. P., 13, Pelham Crescent, Kensington	5	5	0
Beadle, F. J., C. C., The Oaks, Belvedere, Kent ...	2	2	0
Beadle, Fred, Erith, Kent	1	1	0
Beadle, H. E., The Road Co., Gravesend, Kent ...	1	1	0
Basted, Paper Mills Co., Ltd., near Sevenoaks, Kent	5	5	0
Baker, G. P., Swaislands Block Printing Co., Crayford, Kent	5	5	0
Burroughs, Welcome & Co., Dartford, Kent ...			

See Appendix II.

Subscriptions,
or Donations,

Beadle, Clayton, Melrose, Sidcup, Kent ...	...	5	5	0	
Beadle, J. C., Broad Oak, Sutton-at-Hone ...	...	2	2	0	
Brown, S., Paper Wrapper Co., Crayford, Kent ...					
Berens, R. B., J.P., Kevington St. Mary Cray, Kent					See Appendix II.
Balston, W. & R., Paper Mills, Maidstone ...	...	5	5	0	
Beasley, Charles, Brewer, Plumstead ...	...	3	3	0	
Bevington, Col. S. C., J. P., Merle Wood, Sevenoaks, Kent ...	...	1	1	0	
Bevington, R. W., The Thorns, Sevenoaks, Kent ...		1	1	0	
Curtis & Harvey, Ltd, 3, Gracechurch Street, E.C.		5	5	0	
Cook, Capt. E. B., Roydon Hall, Tonbridge, Kent					
Cook, Ralph W., Roydon, Tonbridge, Kent ...	...				
Corke, D. T., Cray Bank, Foots Cray, Kent ...	...	1	1	0	
Colyer-Fergusson, T., Ightham Mote, Ivy Hatch, Sevenoaks ...	...	1	1	0	
Cornwallis, F. S. W., Linton Park, Maidstone, Kent		5	0	0	
Clemetson, E., Hope Mill, Goudhurst, Kent ...	...	1	1	0	
Courthope, G. J., Whiligh, Hawkhurst, Kent ...	...	2	0	0	
Chambers, William, Manor House, Southfleet, Gravesend ...	...	1	1	0	
Chaplin, Ernest, 6, Princes Street, London, E.C.		1	1	0	
Cannon & Gaze, Ltd., Bexley, Kent ...	...	1	1	0	
Daniels, J. R., Bostal Hill, Whitstable...	...	1	1	0	
Dartford, Brewery Co., Ltd., Dartford, Kent ...	...	2	2	0	
Dashwood, Mrs., The Uplands, Bexley, Kent ...	...	3	3	0	
Daily Telegraph, Fleet Street, London ...	...				See Appendix II.
Ekman Paper & Pulp Co., Ltd., 57½ Old Broad Street, E.C. ...	...	10	10	0	
Earle, Vavasour, Franks Hall, Farningham, Kent		3	3	0	
Egerton, P. R., Vale Mascal, Bexley, Kent ...	...	5	0	0	
English, Col. T., Hawley, Dartford, Kent...	...	3	3	0	

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or Donations.

E. C. Powder Co. Ltd., Green Street Green, near								
Dartford ...	...	...	...	...	...	5	5	0
Fisher, Fred, The Mount, Farningham, Kent	...					1	1	0
Fox & Sons, Oak Brewery, Farnborough, Kent	...					10	10	0
Fox, William, Westerham, Kent	...			...	...	1	1	0
Fleet, Algernon M., Darenth Grange, Dartford, Kent						2	2	0
Fleet, Mrs., Darenth, Dartford, Kent	...			...	...	2	2	0
Figgess H. Hockenden, St. Mary Cray, Kent	...					1	1	0
Fox, William, Chelsfield, Kent	...			...	...	1	1	0
Gordon-Lennox Lady George, Roydon Hall, Tonbridge	...	...	...	...	...			
Green, J. B. & Son, Hayle Mill, Maidstone, Kent						1	1	0
						See Appendix II.		
Gilman, H. E., Sutton House, Hawley, Dartford	...					1	1	0
Holt, Vesey, M., Mount Mascal, Bexley, Kent	...					5	5	0
Howard, W. & Son, Chartham Mills, Nr. Canterbury						2	2	0
Hewitt, J. J., Stone Court, Greenhithe, Kent	...					1	1	0
Harris, Lord, Belmont, Faversham, Kent	...			...	...	1	1	0
Hall, J. & E., Engineers, Dartford, Kent	...			...	...	5	5	0
						See Appendix II.		
Holland, Col. F. J., C.B., Ephraim House, Tun- bridge Wells	...	...	...	...	...	1	1	0
Jarvis, E., Littlebourne Mill, Near Dover	...			...	...			
Joynson, E. H. Chislehurst, Kent	...			...	...	10	10	0
Joynson, W. & Son, St. Mary Cray, Kent	...			...	...	See Appendix II.		
Kekewich, L. P., Lamorbey Park, Sidcup, Kent	...					1	1	0
Keyes, S. K., Daren Mills, Dartford	...			...	...	2	2	0
Kidd, Col. West Hill House, Dartford	...			...	...	3	3	0
London Paper Mills Co., Ltd., 27, Cannon Street, E.C.								
Lloyd, Edward, Ltd., Daily Chronicle Paper Mills, Sittingbourne	...	...	...	...	...	10	10	0
						See Appendix II.		
Leaf, W. B., Park House, Eynsford, Kent	...			...	...	5	5	0

	Subscriptions. or Donations.		
Lewis, W. Leach, Margate College, London, ...			
Luck, Col., The Hermitage, West Malling, Kent ...	1	1	0
Mildmay, H. B., M.P., Shoreham Place, Shoreham, Kent	5	5	0
Molesworth, Sir Guildford, Manor House, Bexley, Kent	1	1	0
Mackay, H. R., Petham House. Nr. Canterbury, Kent	2	0	0
May, W., Northfield, St. Mary Cray, Kent ...	5	5	0
Master, C., Barm Green, Oxted, Surrey	2	2	0
Norman, A. C., The Rookery, Bromley Common, Kent	2	2	0
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Orchardson, W. Q., R.A., Hawley House, Dartford			
Pearce, T. Hughes, Ashby Road. Tamworth ...			
Pitt, Col. F. H., Turkey Court, Maidstone, Kent ...	20	0	0
Patrick, Collin E., 8, Buckingham Palace Gardens, S.W.	1	1	0
Paper Makers' Association, 5, Laurence Pountney Lane	50	0	0
Rogers, J. M., Riverhill, Sevenoaks	1	1	0
Reffells Bexley Brewery Co., Ltd., Bexley, Kent ...			
Russells Gravesend Brewery, Ltd., Gravesend, Kent	3	3	0
Reed, A. E., Horton Kirby Paper Mills, Dartford	10	10	0
Reed, A. E. & Co. „ „ „			
Simmons, B., Jubilee Cottage, South Darenth, Dartford	2	2	0
Smith, J. J., Cedar Lawn, Sutton-at-Hone, Kent ...	1	1	0
Smith, R., May Pole, Chelsfield, Kent	1	1	0
Sackville, Lord, Knole, Sevenoaks, Kent	1	1	0
Style & Winch, Ltd., Medway Brewery, Maidstone	1	1	0
Smith, W. Laurence, 31, Portman Square, London	1	1	0

See Appendix II

Subscriptions.
or Donations.

Tolhurst, A , Northfleet House, Northfleet, Kent ...	1	1	0	
Turner, R. D. & Co., Roughway Mills, Tonbridge, Kent	2	2	0	See Appendix II.
Tipping, Col., Brasted Place, Brasted, Kent ...	2	2	0	
Talbot, J. G., M.P., 10, Gt. George Street, S W. ..	1	1	0	
Till, E.D., The Priory, Eynsford, Kent	1	1	0	
Vinson, Edward, Halfway Street Farm, Sidcup, Kent				
Vansittart, Capt. R. A., Noath Cray Place, Fooks Cray	2	2	0	
Waring, S J., Jun., Fooks Cray Place, Fooks Cray, Kent	1	1	0	
Whitehead, Miss C. R., Barnjet, West Barming, Kent				
Whitehead, Sir James, Wilmington Manor, Dartford	2	2	0	
Whitehead, S., Hook Green, Wilmington, Dartford	1	1	0	
Wicks, A., Hollingbourne, Maidstone				
Wilmot, George, Shoreham Mill, Sevenoaks, Kent	5	0	0	
Wreford, W. L., Broughton House, Dunton Green, Sevenoaks	1	1	0	
Warren, E. C., New Brompton, Kent	1	1	0	
Watson, J.B., British Uralite Company, Higham, Kent	1	1	0	
Wood, G. & Son, Ltd., Gravesend Brewery. Gravesend	3	3	0	
Watney, Norman, Valence, Westerham, Kent ...	10	10	0	
Walker & Son, Ltd., Wellington Brewery, Gravesend	3	3	0	
Warde, Lt.-Col., Squerres Court, Westerham, Kent	2	2	0	
Warde, Col C.E., M.P., 17, Lennox Gardens, S.W.	2	2	0	

APPENDIX II.

*List of Guarantors with amounts guaranteed to defray costs of
Opposition to Kent Water Bill, 1902.*

						£	s.	d.
Messrs. W. Joynson & Son	...	...	...	...	...	250	0	0
„ Albert E. Reed	...	...	...	...	...	200	0	0
„ Edward Lloyd, Ltd.	...	...	...	...	...	200	0	0
„ Daily Telegraph Co.	...	...	...	...	...	200	0	0
„ Burroughs, Welcome & Co.	...	...	...	...	...	100	0	0
„ J. & E. Hall	...	...	...	...	...	100	0	0
Richard B. Berens, Esq.	...	...	...	...	...	50	0	0
Messrs. R. D. Turner & Co.	...	...	...	...	...	50	0	0
„ R. Barcham Green & Son	...	...	...	...	...	10	0	0
						£1,160	0	0

APPENDIX III.

Since completing the pamphlet we have received a transcript of Deputation to Mr. Long, which we give verbatim.

GRAND COMMITTEE ROOM, WESTMINSTER HALL,
Wednesday, 29th October, 1902.

PROTECTION OF WATER SUPPLIES.

DEPUTATION

TO

THE RIGHT HON. WALTER HUME LONG, M.P.,
President of the Local Government Board, etc., etc., etc.,

FROM

THE COUNTY COUNCILS' ASSOCIATION,
 THE SANITARY INSTITUTE,
 THE BRITISH ASSOCIATION OF WATERWORKS
 ENGINEERS, AND
 THE UNDERGROUND WATER PRESERVATION
 ASSOCIATION.

THE PRESIDENT was accompanied by:—

SIR S. B. PROVIS, K.C.B. (*Permanent Secretary*),
 MR. HERBERT E. BOYCE,
 MR. W. H. POWER,
 MR. A. B. LOWRY (*Private Secretary*.)

THE DEPUTATION consisted of the following:

COUNTY COUNCILS' ASSOCIATION,
 THE RIGHT HON. SIR JOHN E. DORINGTON, M.P.,
Chairman, GLOUCESTER C.C.
 THE RIGHT HON. T. F. HALSEY, M.P., *Vice-Chairman,*
 HERTFORDSHIRE C.C.

MR. E. J. HALSEY, *Chairman*, SURREY C.C.
 MR. H. HOBHOUSE, M.P., *Vice-Chairman*, SOMERSET C.C.
 MR. J. H. JOHNSTONE, M.P., WEST SUSSEX C.C.
 MR. M. F. BLAKISTON, *Clerk*, STAFFORDSHIRE C.C.
 MR. H. E. CLARE, *Clerk*, LANCASHIRE C.C.
 MR. W. J. FREER, *Clerk*, LEICESTERSHIRE C.C.
 MR. C. E. LONGMORE, *Clerk*, HERTFORDSHIRE C.C.
 MR. G. MONTAGUE HARRIS (*Secretary*.)

Sanitary Institute.

SIR ALEXANDER BINNIE,
 MR. A. WYNTER BLYTH (*Chairman*),
 MAJOR R. H. FIRTH,
 MR. WILLIAM WHITAKER, F.R.S., F.G.S.
 MR. J. E. WORTH, L.C.C.,
 MR. E. WHITE WALLIS, F.S.S. (*Secretary*.)

British Association of Waterworks Engineers.

MR. W. MATTHEWS,
 MR. R. E. MIDDLETON, M. INST. C.E.,
 MR. C. H. PRIESTLY,
 MR. PERCY GRIFFITH (*Secretary*.)

Underground Water Preservation Association.

MR. WILLIAM MAY, F.R.G.S., F.G.S.
 MR. CLAYTON BEADLE, F.C.S. (*Secretary*.)

LORD EDMUND FITZMAURICE,
 MR. HUMPHREYS-OWEN, M.P.

MR. HEYWOOD JOHNSTONE, M.P.:—"Sir, I have to introduce to you this afternoon a joint deputation from the County Councils' Association, the British Association of Waterworks Engineers, the Sanitary Institute, and the Underground Water Preservation Association, four bodies whose names shall be handed to you, as also the names of the gentlemen representing them on this occasion. We desire in the terms of a Memorandum

prepared by a Committee of the County Councils' Association and adopted by the County Councils' Association as a whole, which Memorandum I think has been before you, to call your attention to the "question of the protection of sources of water supply in England and Wales and to the pressing necessity for an enquiry into the existing state of the law on the subject. In so doing they proceed on the assumption: firstly, that the question is one of great and increasing importance to the community at large; and, secondly, that the laws governing it are defective and faulty." I need not call your attention at any greater length to this Memorandum, but I should like to point out to you one illustration on page 2 which shows the nature of the case which does arise from time to time and especially ought to be guarded against in the public interests, and that is that certain districts supplied by a local water company found themselves in danger of losing that water supply from the operation of a Waterworks Company which purchased a small area of land within the area of the local body, proceeded there or intended—I do not think they got so far—but they contemplated sinking a well there and arranged with a railway company to carry their pipes along the line, and they would probably have been able to pump the whole district very nearly dry, to carry the water to their own profit, and to carry it somewhere else far away from its source. It is not an isolated instance, and to account for my own presence here I may say that my attention has been recently drawn to exactly the same sort of thing in my own constituency where a small and somewhat indigent local authority having at considerable expense an excellent and very necessary supply for its people now find themselves in danger of being deprived of that supply by the members of a body which was going to build a hospital and sink a very deep well, and in all probability carry off the water supply of the local authority within whose neighbourhood they were, but they came to terms. As to the existing state of the law there is no protection for underground water which cannot be proved to flow in some definite and known channel."

"As to the Memorandum dealing with legislation I may say that I am a member of the Court of Referees and the subject has been frequently brought to my notice from the hardship which occasionally arises from persons whose water supply is very greatly threatened having no *locus standi* before private Committees of the House. Of course that only refers to the case where Parliamentary powers are required at all; where local Parliamentary powers are not required the local authorities are absolutely helpless, and the pumping of underground sources of water supply goes on. It is only during the last two Sessions I think that the House has given even a discretionary power to the Court of Referees to allow persons whose water supply is threatened in this way to appear and be heard before Committees. I know a case which came under my own observation in the Court where the Corporation desired to purchase a farm and to sink wells thereon and to supply their own people at a considerable distance. Where this farm was situate there were adjoining farms belonging to an owner whose name I do not mention who would have been certainly in danger of being deprived altogether of their water supply or else they would have had to pump it at a very much greater cost, and apart from the special powers to give him a *locus standi* the owner was fortunately in a position to take action, or he would have been helpless and would have been obliged to stand by and see the source of his water supply either very seriously impaired or else altogether taken away."

"I will now call upon the different speakers who have been appointed to address you to set forth their views from their particular point of view, and having heard them you will be able to say whether you can accede to their request, and after due consideration we hope you will see your way to urge upon His Majesty's Government the desirability of appointing a Royal Commission to investigate a matter of so much importance and so much difficulty, and upon which the state of the law at the present time is so uncertain and indeed so unsatisfactory."

Mr. Halsey, who appears for the Surrey County Council and as representing the County Councils' Association will now address you.

MR. E. J. HALSEY:—"I am very much obliged to Mr. Heywood Johnstone for having put this matter before you so much better than I can myself, perhaps. He spoke with reference to this particular question upon this Memorandum, page 2, with reference to the larger Water Company very nearly swallowing up the smaller one and it is that case which caused me to take up the matter before the County Councils' Association three years ago and which I felt was a very serious one and might be repeated elsewhere and against which there was no remedy."

"I should like to say at once that I come before you, representing the County Councils' Association, with no suggested remedy, with no scheme as to what authority or who is to have the jurisdiction over the supplies of this country, but simply to request that the whole of the evidence may be put before a Royal Commission, and an authoritative opinion given which, we hope, might reconcile the different views of parties that are interested in this matter. I say that at once because the County Councils' Association did assay a draft Act of Parliament as a remedy for this matter, but they very soon found that in this water question, as is the case in a good many different things, it would be absolutely impossible to try and force their opinions until really proper investigation should have taken place on the whole subject. We were influenced a great deal by what other people told us in this matter. You will hear presently from the British Association of Waterworks Engineers that in June, 1899, they passed a resolution "that the water supply is a subject of national importance and ought to be under national control or supervision." They are an important body and would not have passed a resolution of that kind without going into the question thoroughly."

"I notice that the Institute of Public Health met at Exeter in August of this year, the Earl of Iddesleigh in the Chair, and in the course of his opening address said, "*inter alia*,"

as follows":—"Another subject of great importance was that of the use and abuse of our water supplies. If he were an absolute Emperor he should appoint a department of the Government to deal solely with water administration. He should expect that department to prove beneficial to the community by the wise exercise of its discretionary powers, and, to a greater degree, by reason of the knowledge which it would slowly accumulate and place at the disposal of the country. One simply could not exaggerate the vital consequences of exact knowledge concerning water supplies, either in respect of health or wealth."

In an enquiry recently in Surrey, the Duke of Northumberland, wrote:—"I am strongly of opinion that the whole question of water supply all over the country should be thoroughly gone into by a Royal Commission or something of that sort, and the way in which we are conducting a happy-go-lucky scramble for water is most undesirable; but until some inquiry is held I fear there is nothing for it but to do the best we can."

"That is an important evidence of the difficulty of dealing with this question. As you are aware, the Duke of Northumberland has large properties in Surrey and elsewhere, and he has experienced very great difficulties and so have the local bodies also. It is not only a question of the supply of water being sufficient for the nation at large, or regulating the sources of supply, but it is also necessary in connection with that to regulate to a certain extent the use of water, that is to say, to avoid that terrible waste that is going on in certain districts of this country. That is all set out in this Memorandum, and the enormous waste of waters in some of the pits in the Midland Counties and elsewhere, where, instead of tubbing every shaft as they used to do, they find it more economical to let the water run to waste, thereby making material difference to the water supply of the neighbouring districts. There is an immense quantity of water running to waste; and it is also an undoubted fact that there are many parts of the country

where the supply of water is barely sufficient, and where the economical and judicious use of machinery to prevent waste would be of the greatest possible advantage."

"I think when you have heard the evidence of gentlemen who are very much more expert and capable of forming an opinion upon such a matter as this than we of the County Councils' Association, that when you find us joining them, knowing the different interests of our various localities and when we are all of one opinion that a definite enquiry is necessary, you will admit that the case is strong, at any rate; whether it is sufficiently strong for the Government to grant what we wish is another question. But it is a strong one and it is almost entering into our daily life in the country and we should be glad to see a satisfactory solution of it."

"Of course, in connection with the water supply there are other matters such as the question of pollution, and the necessity of pure water, and water for sanitary purposes. Upon that subject another gentleman will speak; but I would like to point out that if there is no water there can be no pollution of water. What we want is enough water and having got enough we think it should be served pure and bright to everybody."

"Of course there is this great question of the private right of water which will be referred to the Commission to consider, I assume. It is emphasised by what Mr. Heywood Johnstone has said and it is perfectly well known that this right of private water as decided by law makes the question a much more difficult one. It will have shortly to be decided as to whether that is to remain the law or whether the law is to be altered for the benefit of the public at large without detriment to the private owner as regards his own private property."

"Then the question of the supply of water to the manufacturers and so on—in fact it is so broad that if one desired to go into it it would occupy too long a time. What I have said, and what other speakers will say to you will be sufficient

to recommend to your colleagues that this matter is of vital importance to the country and the sooner it is taken in hand by a Royal Commission the better; because meantime the water supplies of this country are being for some reason or other—there are different reasons why—rapidly depleted, and difficulties are arising frequently through many districts with reference to that matter. I leave it in the hands of gentlemen more competent to deal with it than myself.”

Mr. PERCY GRIFFITH:—“Sir, I have been asked, as Secretary of The British Association of Waterworks Engineers, to take this matter up as it was thought by the members that I could lay this matter before you, being conversant with the facts. Our Association was formed in 1896 and among the objects for which it was formed were the following:—‘assisting the Legislature, public bodies and others in ascertaining the views of those interested in waterworks, undertakings, and originating and promoting improvements in the law relating to waterworks. We are therefore appearing strictly in accordance with the objects of our institution. The position of the Association is that it is representative of the Waterworks Engineers not only of this country but of the Colonies. This subject which is now brought before you was taken in hand as early in June 1899—a very few years after the Association was formed. I mention that, to indicate the fact that as soon as the Water Engineers formed themselves into an Association their attention was brought to this question at once and I suggest that as a proof of its urgency. At that meeting a resolution was passed which was sent to you and I have no doubt has received your attention. Various points were dealt with in it which I think I need not refer to or take up your further time with; but the broad lines were that some alteration was required in the Waterworks of this country. The matter was not then allowed to drop. A committee was formed to continue the subject with a view to further action being taken on the subject. This Committee reported to the Council in November, 1900, and their report was submitted to a General

Meeting of the Members, on December 8th, 1900, when it was duly adopted and ordered to be printed and circulated. This document has also no doubt been brought to your notice, but it will be perhaps advisable for me to summarise the substance of it, as it forms the main ground for our appearance before you to-day. It is divided into seven heads, with remarks attached to each, as follows :—(1) The present system of control over undertakings for public water supply is unsatisfactory. After pointing out the difficulty and expense involved by the distribution of the chief control between the two Houses of Parliament, the Board of Trade and your own Honourable Board, the report suggests that the procedure in connection with water schemes could be greatly simplified and cheapened and that the decision of the supreme authorities would be rendered more uniform if all points of policy were referred to a new single authority and points of detail and engineering dealt with by independent experts. A further suggestion is made that in order to secure a proper public water supply in some rural districts, assistance should be afforded by the wealthier towns in the immediate neighbourhood. (2) The existing powers for enforcing a proper water supply are inadequate. Under this head attention is called to the difficulty in effectually fixing the responsibility for affording a water supply to any district upon any person or body, and to the fact that so many rural districts are at present without a proper supply and without any practical supervision of what supply there is. (3) The areas allotted to existing local authorities are altogether independent of the sources of water supply. In this connection it is pointed out that the limits of existing sanitary districts are often very inconvenient with respect to the supply of water, and that the existing facilities for joint action with regard to any particular sources, are inadequate and unnecessarily costly. This is no doubt the most important ground on which His Majesty's Government are asked to take action. Our Association does not necessarily agree with the suggestion of the Sanitary Institute (also represented to-day) that the districts of sanitary and water authorities should in every case be co-

terminus; but we do feel that the existing haphazard manner in which the limits of water authorities are fixed (particularly in the allocation of different sources of supply) is extremely unsatisfactory.

(4) The law relating to underground water is inequitable and a standing danger to many public water supplies. This is a point which the County Councils' Association are taking up more fully than our Association, but our position is briefly this:— That some means should, if possible, be found to prevent the sources of existing public supplies being interfered with.

(5) The law relating to pollution of water requires revision. This is a question with many bearings, among which may be mentioned (a) the pollution of supplies at the source (that is, before use). (b) the pollution of water in course of pumping, filtering, storage or distribution. (c) the detection of such pollution in time to prevent its use by the consumers, and (d) the prevention of pollution under all conditions.

At the present time the law provides no certain means either of detecting or preventing pollution, neither does it provide any effective penalty for the supply of polluted water and consequent loss of life. It is not of course suggested that any legal restriction could adequately cover all the points involved under this head, but is respectfully urged that some provision should be made to fix the responsibility for periodical examination, and, where necessary, interference to prevent the recurrence of such disasters as befell the towns of Maidstone, King's Lynn, and Worthing, in recent years.

(6) The provisions for preventing waste are insufficient. The existing provisions for regulating the use of water and preventing waste are so diverse, and in many cases so ineffective, that we consider the general law urgently requires consolidation and revision with a view to the reduction of waste generally, as water must in most cases be dealt with a second time in the form of sewage, thus involving double expense, we suggest that the remedy of existing evils in this respect would effect a considerable economy to all consumers and ratepayers concerned.

(7) The collection and publication of official returns relating to existing undertakings, is much to be desired. Our Association has already taken steps towards this end, by an endeavour to

collect statistics of all the water undertakings in this country, of a more comprehensive nature than any previously obtained, but it is obvious that a complete return is impossible except under Government compulsion or authority such as applies to gas undertakings. There can be no doubt that such returns would be of enormous value in dealing with questions of water supply generally. The last part of the report is with reference to official returns. Beyond the points raised in this report there are many others which have been subject to discussion by our Committee. Some of these are matters of detail which must inevitably arise in any consideration of the question as a whole, but two are of sufficient importance to warrant special mention:—(1) The relations existing at the present time between local authorities and water companies, whether as competitors for ownership of the public supply of water or otherwise, are very unsatisfactory. The existing law appears to involve much friction and expense which might be prevented by a more definite enunciation of the powers and responsibilities of the contending parties. As our Association is representative of both Company and Local Authority undertakings we have no direct interest in the question as to which system is preferable, but we do feel that the present condition of affairs is the cause of serious interference with the practical efficiency of many existing undertakings and the cause of much needless delay in the supply of water to towns and districts at present without a proper public supply. (2) The other point we desire to bring before your notice is that the existing general waterworks law urgently requires consolidation, and private Bill legislation should be rendered more uniform than it is at present. Local Authorities administering the public water supply are governed by at least six general Acts and many have Provisional Orders of your Honourable Board or Private Acts of Parliament containing very divergent provisions. Many Companies' undertakings and those owned by private individuals are under no Parliamentary control whatever, others are governed by Provisional Orders of the Board of Trade incorporating three general Water Acts and a large number of Companies' Acts, and others again by Special Acts incorporating the general Acts,

but containing extremely divergent provisions as to general responsibility and management. In conclusion, I am directed to urge that upon the grounds stated there exists urgent necessity for the appointment of a Royal Commission or Parliamentary Committee of Inquiry to deal with the question of water supply throughout this country."

MR. MATTHEWS, *Past President, British Association of Waterworks Engineers*),:—Sir, on the question of legislation, taking one point, it is to our mind in this position: The Waterworks Clauses Act of 1847 and 1863 on the preamble stated that owing to certain clauses having in recent years been put into a number of Acts of Parliament the time had come when they should be consolidated into a General Act. Our point in connection with legislation is that it has in recent years become so necessary to put model clauses into practically every local Act on water supply which is brought in that the same state of things is existing now, and that these various clauses and others which after consideration might be deemed desirable should be put into a general Act. Unfortunately some of the clauses of the Public Health Act of 1875 and the clauses in the Waterworks Clauses Acts of 1847 and 1863 are quite inconsistent with one another, and therefore revision is necessary there."

"As to the question of control as to which Mr. Halsey made some remarks, it is a fact that at the present time the amount of control which can be exercised over the water supply is exceedingly limited; there are no powers by a local sanitary authority over the property of any water company or of any sanitary authority which might be supplied. It is also a fact on the cases or authorities under similar conditions given to most of their local Acts they can acquire certain lands by agreement, and having acquired those lands by agreement they can put up works subject to no control whatever. They are not obliged to go to Parliament or to your Board for sanction to carry out the works, which works might be good, bad or indifferent. The consequence is that certain works which had they been brought under the control of Parliament or your Board, would never have been sanctioned or

carried out. Then afterwards there is no supervision even though works may be carried out with the sanction of Parliament or of your Board, those works having been sanctioned, provided they are within the limits of deviation, there is no supervision afterwards to see that the spirit of the Act is carried out properly. Your Board gives sanction to carry out a certain water supply. You have no power to say "This has not been carried out according to the proper conditions and we will have the work done over again."

"Then with regard to what is to be the hereafter of the water supply, we offer no expression of opinion as to what should be the constitution of any Board or Boards which shall take up the question, but we do say that the existing state of things is purely parochial and that the question of water supply is far beyond the parochial question and should not be left in the position in which it now is, but that some authority which has not the same purely financial control in the thing should have some say in the question of how and in what manner these things shall be carried on."

"Those are the principal points which we urge upon you, that it is actually necessary that some investigation shall be made as to how far the existing state of things is not satisfactory."

"The last Commission which dealt with the question of water supply in the country generally, of course apart from the Metropolis, a question we do not refer to, the last General Royal Commission which sat to investigate the question of water supply in this country was as far back as 1866 or or 1867, presided over by his Grace the Duke of Richmond and Gordon; and it goes without saying that an enormous advance has been made in the way of water supply from that date which warrants the Association in thinking that the time must arise when a particular revision of the whole question underlying such a large subject as that should be brought up again."

Mr. W. WHITAKER, :—"Sir, I need hardly say that the Sanitary Institute consists of members who have diverse interests

and very various opinions. We therefore, in a question of this sort take no side and enter into no controversy. We only wish to put forward considerations which are believed to be for the national good, apart from all mere local questions. In enforcing that, I should wish to lay particular stress, almost the only stress upon purely sanitary matters, but in order to do that properly I must allude in the first place to some general considerations."

"The first of these is that we should ask that if such an inquiry should be granted, that it should be a thorough one; that it should take up all sides of the question, and not be limited to any one particular part of the subject. I would say that it should not be limited to public supplies, it should also consider private supplies. I do not mean, of course, mere house supply or anything of that sort, but there are places in which large estates have what may be called a semi-public supply. In any investigation of this sort we think that all these schemes should be considered and reported on as much as public supplies. Besides these, of course, there are in some places very large, what we may call trade supplies; there are trades in which the supply of pure water is absolutely essential, sometimes in small quantity and sometimes in large; at any rate, there are very many trades in which a large quantity of water must be used. We think that the investigation should include those supplies also, so that we may know in any given area what the whole of the supplies are, and not merely those used for public purposes."

"Besides that there is another matter—it is not a question of supply—it is a question of water extraction. One part of that has been alluded to by Mr. Halsey. In our coal districts very often it happens that a large supply of good water is pumped to waste. We think that the enquiry should certainly include such subjects as the pumping of water to waste, and it is not only in mining countries that this happens; it occurs also to a very large extent where quarrying is going on. I have heard of a case where several millions of gallons per day of water—of presumably good water—being very much the same as used for the public supply—that a large quantity is pumped out of a quarry in order

that more stone or what not may be got. We think that the Inquiry should take in all these circumstances as well. There are public works, such as millers, brewers, engineering works, in which it is essential sometimes that a large amount of water should be pumped, and there is a case, a fairly well-known case, where something like 15 millions per day is pumped and pumped to waste, and I am informed that it does not improve some of the neighbouring wells in their yield. We think that these yields should be a matter of inquiry as well."

"Then coming to the more sanitary aspect of it which, as I say, cannot be thoroughly entered into without these other questions, and I will give an illustration of that. We know of a case of large engineering works where water is pumped out, and that water is not only fresh water but salt water, which is pumped in from a neighbouring estuary. The result of that probably is that the salt water goes beyond that area of pumping and it is possible that it may affect neighbouring wells in the way, not by taking their water simply, but of supplying it with salt water or partly so. Those are things for inquiry.

"Then coming to the worst aspect that has been alluded to, we think there should be protection for water supplies, largely of course protected from interference with other folk seeking supplies, that there should be some protection in quantity; but we, as sanitarians, are largely concerned in the protection of quality. As things are at present it is quite open to anyone to supply the neighbouring water company very easily. I heard of a case a little time ago where some wells were got rid of to go into a sewage scheme, and not particularly far off water works. There are many cases of this contamination, whether from sewers, cemeteries, or trade waste. There are questions as to the distance they are efficacious for harm, and very diverse opinions are held. We think that these particulars should form one of the subjects of the inquiry which we ask you to establish. We know a case—it is a risk very often of a water authority who knows that their supply has a risk of contamination; they are perfectly willing to put it right and

perfectly willing to go to some expense to safeguard their supply, and they are met with legal and other difficulties which really are very trying. That, certainly, is not a sort of thing that ought to be. If you have a company or authority who is willing and agrees to do the best it can to protect its water from evil, it should not be discouraged but rather encouraged in so doing. At present the balance is rather in favour of discouragement. We ask simply for an inquiry as to the fact, an inquiry which, when this fact was well established, should be followed by a suggestion for legislation. We ask for this inquiry so that water may be used in the best possible way in the future and with the least possible damage to all interests, public and private.

Mr. WILLIAM MAY:—"The Underground Water Preservation Association was formed in the early part of this year owing to the sources of water, principally in the West Kent, becoming practically arrested. The Association was formed by many noblemen and gentlemen, and mill-owners, and brewers, and tradesmen, who were all affected by the drying up of the streams. Since this Association was formed, investigation has been made, and the facts that the Association has ascertained are clearly, first that the streams in West Kent have in several instances ceased to exist. I could enumerate at least five. It was said they had ceased to exist because the rainfall had not been kept up; but we have gone very systematically into the rainfall question, and we are satisfied that if the rainfall had kept up to the average there was not enough rainfall to fill up the vacuum caused by the water that has been abstracted. We have gone thoroughly into the matter, and we have obtained the best advice that we could possibly have—we have had it statistically before us, and we are satisfied that the depletion of the water, principally in West Kent, is a most serious matter. Not only is it serious to manufacturers, brewers and others, who are dependent on a large source of water for their business, but it is most important from, I may say, the agricultural point of view. We collected evidence that large, old, standard trees,

that had possibly been in existence for 100 or 200 years, were dying. We also ascertained the fact that, when we had samples several feet below the soil—where it used to be in former times full of water—it was as dry, as one man said, as a turnpike road. The fact is that the rainfall is so at once taken up that there is nothing left for the surface.

“Then, again, we have had the difficulty in the sanitary point of view of our streams having dried; we come into this position: What are we to do with them being dried up—they are simply sources of great pollution? We call upon the riparian owners to cover places in, but what are we to do? It is a matter the County Council of Kent have taken up and they are considering it, a most important question.”

“We have also ascertained, that although we believe there is the most abundant supply of water at the present moment at the mouths of the rivers, yet we know as a fact, in Essex that they can only pump a few hours per diem, because, if they pump more, in comes the brackish water, and there is no reason whatever to suppose that these pumping stations at the mouths of rivers can be used in the same way as if they were pumping from an inexhaustible supply.”

“The Association of Underground Water Preservation has ascertained without the slightest doubt that what is called the underground basin of the Thames is being exhausted of its water, and it only requires a few more years and the extension of pumping to go on, when that water will cease.”

REPLY.

THE PRESIDENT :—“I am very much obliged to you for putting the case before me as clearly as you have done. I think there is no dispute, certainly among people who have had to look into this question, as to the gravity of the case which you have put before me to-day, or, indeed, as to the main facts

which have been described here. We have had abundant evidence of the very worst pollutions of our water supplies in different parts of the country, and there has also been abundant evidence of the fact to which reference has been made by nearly every speaker, that frequently water is abstracted—what I may term a limited use—which ought to be available for more general use in the neighbourhood to which it belongs.”

“The three questions which you have been good enough to bring before me to-day, are pollutions, waste, and what I may describe, generally speaking, as water rights.”

“With regard to pollution, as you are aware, there is a Royal Commission sitting at the present moment, enquiring into pollutions from sewerage and similar causes, and the reference to it is a very wide one. They have already, as you probably are aware, issued an interim report, and I have the advantage of counsel and assistance in the Local Government Board of a distinguished member of that Commission, Mr. Power, who is the head of the Medical Department, and, therefore, I have been able to discuss with him, before this Deputation arrived, what the view is which is taken by the Royal Commission of their power with regard to general enquiry. They have issued an interim report, and one of their recommendations is this:—‘We are of opinion that the general protection of our rivers is a matter of such grave concern as to demand the creation of a separate Commission or a new Department of the Local Government Board, which should be the supreme rivers’ authority dealing with matters relating to rivers and their purification, which, when appeal is made to them, shall have power to take action when the local authorities have failed to do so.’ How far they would consider that the recommendation was intended to cover not merely rivers but other sources of water supply, of course it is not possible for me to say, but I do not think that it is in the least probable that they would have put forward that recommendation if they looked only to sources of supply which are drawn from rivers. They are still

continuing their labours, and I should be extremely reluctant to recommend the Government to appoint a Commission whose Reference might seem to trespass upon the territory of the existing Commission. I should ask, in reference to this question of general pollution, that a time should be given me to learn what the opinions of this Commission are. They will, no doubt, be made acquainted with what has taken place here to-day ; they will have the opportunity of reading the statements which have been made by various speakers, and I hope that they will, perhaps, think it wise and right to consider the matter and, possibly, make some communication as to the view they take of their own powers in regard to this particular question. If they hold that they are precluded by their Reference from enquiry into the general question of pollution, then it might be necessary to include that in any further enquiry, if further enquiry be decided upon. I gather from what I have heard of their proceedings, that they hold that their powers are ample to enable them to enquire into surface water ; the question of surface water and its treatment in order to render it pure, and generally to examine into the position of surface water in this country. Well, if that is so, then it would dispose at all events, of a portion of the demand which has been made for enquiry here to-day, but of course it will not dispose of underground water and the general question of water-rights, to which I will come in a moment."

"Then the second question to arise to which you draw attention is that of waste, and I am bound to say that in reference to the question of waste, I have not got in my possession evidence which points conclusively in the direction indicated by the Deputation to-day. The waste to which allusion has been made by one or two speakers which occurs when mining shafts are being sunk, and other similar works are being carried on is generally of a very temporary character, and I am informed (and I do not put this forward in any way of contradiction to the statements which have been made), I am informed that as a rule where there is a diminution of water

supply in consequence of those operations, it is only of a very temporary nature and very soon ends, things resuming their normal condition. But speaking generally with reference to the waste question, the information which I have got is at present very meagre indeed, and would not justify me in asking that an enquiry into the waste question should be included within the purview of a Royal Commission. Some additional light has been thrown upon the question to-day by the speakers in the statements which have been made, and I have no doubt that what has taken place here may lead to some further information reaching me on the subject. But in regard to the general question of water-rights, I admit that we stand in an altogether different position. I personally have taken considerable interest in bringing in this question long before I came to the Local Government Board, and there can be no doubt whatever that the general position of the law in regard to the protection of existing rights and their proper use for the public benefit, and the practice of local authorities in acquiring the water-rights, that all this is in a very unsatisfactory condition. Not only is it the case as we know by experience that local authorities in their desire to supply their own district with water, frequently entirely deprive the adjoining districts of water which really appears to belong to them; but, while they produce satisfactory results in their neighbourhood in the shape of an adequate supply of pure water, they at the same time produce a dearth in another district which had previously been sufficiently supplied. And therefore on the well-known principle that there is no merit in raising one man out of poverty to a position of affluence, if, at the same time you push down two or three others into a condition of poverty—you can apply the same principle to the water question—it is very undesirable that water should be supplied to a particular area in such a way as to deprive another area to which the water properly seemed to belong, and of which it would have been in enjoyment, should be in consequence deprived of it. This we have had ample experience of, and it is in that way a very unsatisfactory condition of things.”

"Then reference has not been made here to-day, except very generally, to the ownership in underground water-rights or the ownership in surface water-rights, as they are surrounded by privileges which do not attach to the ownership of other classes of property, and it would seem that this is a question which might very well be considered as a matter of enquiry and possibly also of legislation."

"I cannot pretend to-day to go over the whole field covered by the various speakers, because I may point out that some of the speeches which have been made would indicate a necessity for legislation not in one or two Acts of Parliament but in several Acts of Parliament and of a very wide and general character. You know as well as I do the difficulty of promising to carry one Bill through Parliament, but when it comes to promising half a dozen, which is the lowest computation I could make of the suggestions to-day, I think a man would be rash indeed who would hold out hopes of that kind."

"But the question really that you ask me to consider is not that of immediately introducing legislation, because, as Mr. Halsey said in his early remarks, you come here really rather to point out defects than to indicate active or practical reforms. As I have said, I am extremely unwilling to adopt the suggestion which might have the effect of treading upon the heels of an enquiry which is now going on. I should like first of all to be fortified by some expression of opinion from that Royal Commission which I should think in all probability I shall receive as one of the results of to-day's deputation."

"Then with regard to the other questions of water rights and the general law with regard to the provision of water, because a point which has not been raised to-day but which is by no means in a satisfactory condition is the power of Local Authorities to secure that everybody within their area should have a proper supply of pure water. The law already lays that down and provides machinery for the purpose, but I am afraid we must all admit that there are many districts in

the country where the water supplied is neither sufficient in quantity nor is it pure in quality. And therefore, if that be so, that reveals an unsatisfactory state of things which deserves enquiry and which certainly ought to be remedied."

"I hope I have said enough to show that I am very largely in sympathy with the objects you have come here to support. I ask you to permit me not to make a definite promise on this occasion, because I should prefer to examine more completely into the whole question, assisted as I am by the very luminous statements which have been made here to-day, and if I am satisfied that the case is one which ought to be presented to a Royal Commission then, to adopt the words of my friend, Mr. Heywood Johnstone, who introduced the deputation, then to decide to appoint a Commission or a body to enquire into the question and to give them such a reference as would prevent them trespassing upon the ground of an existing Commission, and which would at the same time secure that the whole question of the supply of water and the general rights of water should be enquired into with a view of such legis'ation being introduced as may seem to them desirable."

MR. HEYWOOD JOHNSTONE:—"We are very much obliged to you for your courtesy in receiving us. We note the end of your answer and we quite understand that you have grasped the importance of the subject in all its variety and its complexity, and we leave the matter in your hands; and we are quite satisfied not only with your ability but your sympathy in dealing with the subject."

THE DEPUTATION THEN WITHDREW.

APPENDIX IV.

ROYAL OBSERVATORY, GREENWICH.

ANNUAL RAINFALL, 1841-1900.

			Inches.				Inches.
1841	...	...	33·26	1871	...	...	22·30
1842	...	...	22·57	1872	...	...	30·02
1843	...	...	24·47	1873	...	...	23·36
1844	...	...	23·20	1874	...	...	19·95
1845	...	...	22·34	1875	...	...	27·97
1846	...	...	25·29	1876	...	...	24·10
1847	...	...	17·61	1877	...	...	27·28
1848	...	...	30·10	1878	...	...	28·98
1849	...	...	23·58	1879	...	...	31·36
1850	...	...	19·53	1880	...	...	29·68
1851	...	...	22·53	1881	...	...	25·72
1852	...	...	34·01	1882	...	...	25·18
1853	...	...	29·99	1883	...	...	21·91
1854	...	...	19·01	1884	...	...	18·05
1855	...	...	23·59	1885	...	...	24·00
1856	...	...	23·27	1886	...	...	24·21
1857	...	...	21·16	1887	...	...	19·86
1858	...	...	17·70	1888	...	...	27·50
1859	...	...	25·83	1889	...	...	23·28
1860	...	...	31·90	1890	...	...	21·86
1861	...	...	20·45	1891	...	...	25·04
1862	...	...	26·22	1892	...	...	22·31
1863	...	...	19·66	1893	...	...	20·12
1864	...	...	16·38	1894	...	...	26·89
1865	...	...	28·70	1895	...	...	19·72
1866	...	...	30·72	1896	...	...	22·42
1867	...	...	28·46	1897	...	...	22·13
1868	...	...	25·15	1898	...	...	18·85
1869	...	...	24·02	1899	...	...	22·33
1870	...	...	18·55	1900	...	...	22·31
			1901	...	...	...	20·29

APPENDIX V.

SHOWING THE EFFECT OF ELEVATION UPON AMOUNT OF RAINFALL.

No. on map	Height above ordnance datum feet	Average annual rainfall for 1890-1899.
2	20	20.42
16	25	20.83
1	155	22.07
4	170	23.55
9	220	24.35
5	295	24.69
7	296	25.56
13	300	25.84
15	300	24.43
10	350	24.89
11	785	28.86
Averages	264	24.13

DATA

1" rainfall per annum = 62 gals. per acre per diem *in the gross*.
(Dr. Mill).

1" rainfall per annum = 39,680 gals., or say 40,000 gals. per square
mile per diem *in the gross*. (See Report of Lord Balfour's Commission,
page 39).

Taking 32^o/_o, or say 1/3 as percolating (see figures previously cited,) one acre could not yield more underground water than about 13,400 gallons per square mile per diem for every inch of rainfall, nor could a deficiency of one inch per annum deprive it of a greater amount.

Average Greenwich annual rainfall	...	...	1841-1900 = 24.13
"	"	"	1891-1900 = 22.21
		Deficiency	1.92

This deficiency could not account for greater loss to percolating water than about 25,800 gals. per square mile per diem, probably the amount of underground water deficient through this shortage of rainfall would be really less.

APPENDIX VI.
UNDERGROUND WATER

STATISTICS OF RAINFALL IN DISTRICT AFFECTED

Compiled by

No. on Map.	Height above Ord- nance Datum.	Name of Station.	Average during 10 years.			1890	1891	1892
			1870-79	1880-89	1890-99			
	feet 111	Camden Square, N. W. ...	27.24	25.45	22.78	21.23	28.15	22.60
1	155	Greenwich Observatory ...	25.39	23.94	22.07	20.86	25.04	21.31
2	20	Deptford (Kent W. Works)			20.42	20.83	24.15	21.30
3	245	Eltham (High Street) ...						
4	170	Sidcup (Hatherley Road) ...			23.55	21.36	27.22	24.99
5	295	Bickley (High Field) ...		26.28	24.69	24.43	31.10	28.05
6	300	West Wickham						
7	296	Hayes Common			25.56	23.40	31.22	26.86
8	235	Bromley Common						
9	220	Orpington (Kent W. Works)			24.35	21.86	26.91	25.03
10	350	Keston (Bradfield)			24.89	23.39	32.20	26.88
11	785	Knockholt (Kent W. W. Res.)			28.86	26.92	36.11	30.12
12	380	Westerham (Fishponds) ...						
13	300	Sevenoaks (Riverhead) ...		28.37	25.84	25.05	29.75	29.78
14	300	Kemsing						28.56
15	300	Farningham Hill			24.43	21.77	28.87	26.99
16	25	Wilmington (Kent W. Works)			20.83	20.11	24.42	25.62
				78.59	265.49	249.98	316.99	315.49
		No. of Stations ...		3	11	11	11	12
		Average		26.20	24.13	22.72	28.82	26.29

PRESERVATION ASSOCIATION.

BY THE PUMPING OF THE KENT WATER COMPANY.

THOMAS HENNELL.

Fall in each year.

1893	1894	1895	1896	1897	1898	1899	1900	1901
19.80	27.94	21.47	23.52	22.86	17.69	22.54	23.28	22.20
20.12	26.89	19.73	22.42	22 13	18.85	22.33	22 32	20.29
19.78	24.57	17.85	19.53	20.13	16.36	19.75	19.07	18.31
18.13	28 13	19.00	23.14	22.27	17.76	21.94	20.47	20.31
20.31	32.10	19.78	23.97	23.24	19.09	23.41	23.70	21.96
20.06	30.18	20.73	25.50	24.52	18.17	24.17	24.02	22.74
	35.85	24.42	32.27	24.93	21.70	26 11	26.32	24.99
20.02	31.17	21.93	29.31	25.08	21.05	25.53	26.55	
	29.60	20.00	26.51	23.05	19.14	23.47	23.63	22.03
20.90	30.01	19.86	30.64	23.04	21.47	23 78	24.57	22 09
19.69	29.77	21.17	28.78	23.25	20.13	23.68		
21 40	34.07	26.73	33.06	27.89	24.92	27.39	29.43	24.22
24.62	33.60	24.65	31.34	24.29	21.97	24.48	26.11	21.04
21.03	31.37	23.81	29.03	23.28	19.80	25.48	25.79	
20.22	31.37	25.47	33.02	24.80	21.45	27.15	31.08	
20.07	28.50	20.04	28 76	23.13	19.62	26.57	24.83	21.54
17.30	23.13	17.69	23.02	19.69	15.73	21.55	20.92	17.82
283.65	480.31	342.86	440.30	375.32	317.21	386 79	368.81	257.34
14	16	16	16	16	16	16	15	12
20.26	30.02	21.43	27 52	23 46	19.82	24.17	24.58	21.44

APPENDIX VII.

QUOTATIONS FROM DAILY PRESS.

By the courtesy of the editors of "The Daily Express," "The Daily News," and "The Daily Mail," we reproduce certain articles that have recently been published, these clearly show the disastrous consequences of excessive pumping.

We do not profess to agree in every detail with all the opinions expressed or statements made, although in the main we are in agreement. Our object in giving these extracts from the Daily Press is to show to those who have not had an opportunity of following the subject, that the public are now alive to the gravity of the situation.

ENGLAND'S GREAT SAHARA.

How London Sucks up Rivers and Drains Dry Tracts of Country.

"Like the limbs of a great octopus, the gigantic mains which supply London's thirsty millions with one of the necessities of life stretch out into the surrounding rural districts and are draining them dry of water."

"The process is slow, but none the less sure. The unprecedented drought of the summer and autumn would have caused only temporary alarm had it not revealed the fact that in a wide strip of country around the metropolis the water supply has been steadily diminishing for years."

“From Essex, Kent, Hertfordshire, Berkshire, Oxfordshire, and Buckinghamshire comes the same story.”

“In Berks and Oxon so low has the supply of water fallen that millers have had to work short time; while in the hill villages the greatest difficulty has been experienced in obtaining sufficient supplies for man and beast.”

“Essex has suffered to an even greater extent. Wells have failed, people have been driven to obtain water from ditches and roadside ponds, and a serious risk of disease is being run.”

“The water famine in Kent increases in intensity year by year.”

EXCEPTIONAL DROUGHT.

“‘Where we used to have to carry water to the cattle only in times of exceptional drought,’ declares a Kentish farmer, ‘we now have to do so almost all the year round. Wells were never so low a few years ago, even in the driest seasons, as they regularly are now, and at times when the rainfall is not sufficient for ordinary requirements the problem of obtaining water is a very serious and costly one. To keep men and carts employed in bringing water from a distance is a fresh burden upon the agriculturist.’”

“When rain does fall, every can, bucket, and tub is used to collect it, and if drops of gold were falling they could hardly be preserved with greater care.”

“It is in Bucks, however, that the gradual diminution of the water supply has been most strikingly exemplified.”

“Ten years ago the village of Great Missenden, situated in one of the many picturesque valleys of the Chiltern Hills, was the source of the Misbourne River, a tributary of the Colne.”

“A year later the springs which supplied the source ceased running, the river for some miles along its course disappearing at the same time. After a few months the springs began to flow once more, and the river returned. This phenomenon occurred for three years, with longer intervals of disappearance each year, until finally the springs ceased flowing altogether, the river vanished, and neither has been seen since.”

A LOST RIVER.

“Where once were miniature lakes are now grass-covered hollows, the river bed is overgrown with weeds, and soon, under the influence of time and the plough, the fact of its ever having existed will be forgotten.”

“The remarkable disappearance of this river was an omen of much more serious trouble to come. The wells on which the inhabitants of the Chiltern Hills depend for the greater part of their water supply showed signs of giving out. Immediately the dangerous and costly operation of deepening the wells was resorted to, and the famine was temporarily averted.

“During the past summer matters again assumed a serious aspect, and now over a strip of country twenty miles long, stretching from Tring, in Herts, to Amersham and Chalfont, in Bucks, scarcely a drop of water is to be had excepting what can be collected in rain-water tanks.”

“At Great Missenden people have been compelled to shut up their houses and migrate to London. Only one well in the place had any water in it for a time, and farmers were seriously thinking of moving their animals away owing to the difficulty of supplying them with water.”

“Though the rainfall this year has been much below the average, that fact alone will not account for the gradual diminution of the water supply over a period of ten years. The secret of the whole matter lies with the water companies.”

THIRSTY LONDON.

“It will scarcely be believed that the average consumption of water per day of each inhabitant of London is forty gallons, and that every day a total of over 220,000,000 gallons is used.”

“Carrying the calculation still further, we arrive at the astonishing fact that it takes 80,300,000,000 gallons of water to supply the wants of Londoners for one year.”

“While many large towns in Lancashire and the Midlands have been compelled to go to the mountainous districts of Cumberland and Wales for their water, the London water companies are quietly allowed to drain the surrounding country dry.”

"The Metropolis lies in a hollow, and the flow of water from the higher country around is naturally downwards towards this natural cup. As it reaches the level of London, there are the water companies greedily waiting to lap it up. Year by year, as thousands of millions of gallons are drawn off, the supply on the hills diminishes, and drought brings ruin to farmer and landowner alike.

"There is only one solution to the difficulty."

"London must go to Wales or elsewhere for her water supply. The London County Council placed a Bill before Parliament in 1901 with that object in view, but it was rejected. Sooner or later, however, the drought-stricken counties will rise up in protest against this ever-increasing drain upon their natural resources, and then good-bye to the depredations of the water companies."

SAHARA IN BUCKS.

DAILY MAIL. 29th September, 1902.

WATER DISAPPEARING FROM A CHILTERN DISTRICT.

"It will come as something of a surprise to the public to learn that, notwithstanding the heavy rains which have characterised the past summer, a large part of Buckinghamshire is suffering from a water famine."

"The area affected lies high up in the Chilterns, and extends from Amersham to Wendover. For years past the wells in this locality have been slowly drying up, and the level of the water in the chalk has been falling. This has hitherto been ascribed to the enormous amount of pumping for the London Water Companies which takes place on the edge of the chalk area. From time to time the wells have been deepened, in most cases to an extent of at least 10 ft. in ten years, showing a fall of about a foot a year in the great subterranean cistern which is tapped by them. But never before have so many wells run dry as in the past month."

"In one village, Great Missenden, only two wells are now yielding water, and both are showing signs of exhaustion. The people of the place are in great straits for water, and some families have moved. On the hills round there is equal scarcity, and the position of the farmers is a very serious one, as the difficulty of watering their stock is enormous."

"There is, moreover, according to local experts, no prospect of the scarcity disappearing before the spring. If so, it is a difficult problem how the population will manage to live, and there are not unreasonable fears of an epidemic. Though these droughts have been increasing in severity and frequency for years, the present extraordinary lack of water is ascribed by many to the fact that a great quantity of water is being pumped away lower down the valley by the town of Rickmansworth, in the process of laying sewers."

WELLS THAT ARE DRY.

DAILY MAIL, 4th October, 1902

COMPLAINTS OF FAILING WATER SUPPLIES.

"Reports from various districts in the home counties leave no doubt that a very serious scarcity of water exists."

"In many parts of Hertfordshire the question is assuming serious proportions, more particularly on the western side of the county. At Aldbury the shrinkage in the wells is unprecedented. At Cow Roast the pumping operations of the Grand Junction Company are continuous, and to this some attribute the failure of the wells. Meetings have been held in various villages, at which resolutions have been passed calling on the Berkhamsted Rural Council to test the legality of the Company's action in thus depriving the villagers of that which they declare they have the first claim on."

"The situation in Buckinghamshire, as the "Daily Mail" has already pointed out, is equally serious. In Mid-Buckinghamshire many persons have to walk long distances to obtain water, and the authorities are at

their wits' end to obtain water for the population. Sir Oswald Mosley, who has property in the neighbourhood of Stoke Mandeville, is unable to occupy his house there owing to the lack of water."

"A curious circumstance is reported from Chelmsford, where, for seven Sunday evenings, a water-organ at the church has been silent, as the town council deem it wiser to preserve the water in case of it being required for an outbreak of fire."

"Essex feels the shortage more than most counties, for the reason that the rainfall is usually below the average elsewhere. Ten wells in the Newport district are reported to be dry for the first time in their history."

"In order that the work of the Association may be extended to all parts of the country where this subject is becoming of vital importance, it is important that all those who are likely to suffer in the future should lend the Association their support, not only by becoming Members, but by supplying information."

"The fact that so many industries could not exist without a copious supply of good water will compel those who have large interests at stake to combine together with the object of opposing any measures that may threaten their interests. Some manufacturers have thought that if their wells are running dry all they have to do is to sink deeper. This has been done by many of our manufacturers already at very great cost, but there must be an end to deep well sinking. It will be a matter of who can spend the most money. It would be far more to the point if manufacturers, riparian owners, farmers, landowners, and others, combined together with a view to preventing the wholesale abstraction of water affecting their interest."

DECREASING WATER-LEVEL IN THE CHILTERN.

THE DAILY NEWS, 28th October, 1902.

"The Editor of 'The South Bucks Free Press,' referring to the inquiry of 'The Daily News' into the deficiency of water in the Chiltern country, points to one remediable factor in the situation. The drying up

of wells is only partially due to the short rainfall of the last ten years. Pumping for various purposes, he continues, is continually proceeding in the lowlands of the Chiltern district. Water companies are drawing immense supplies, sewerage and constructive works drain large quantities away, and in one case water is being pumped up from the chalk to keep a canal going. In this instance the people living round about Tring have, we believe, appealed to the Hertfordshire County Council to protect their interests. They argue with much force that valuable as the canal is for the transit of merchandise, even the interests of commerce do not justify denuding a district—as they contend is done—of its drinking water, one of the prime necessities of existence. Every now and then the wells in this district have to be deepened in search of the receding water, and some of them have had to go down an extra fifty feet in recent years. The apprehensions of the inhabitants are further deepened by the growing thirst of London for water, and it is felt that the County Councils must take combined action to check the drainage of deep springs. It is a corollary of the unwarrantable extension of the sewer system, which here manifests one of the least of its faults.”



The Water Supply on the Chiltern Hills.

TO THE EDITOR OF THE BUCKS HERALD.

SIR,—I should be glad if you could find space for the insertion of a few statements in respect to a very important matter, viz., the water supply, and the condition of the springs at the present time, with the hope that it may lead to some further correspondence in your valuable columns (should you feel disposed to allow it).

That the springs are unusually low is a fact—in my own case, instead of nine feet of water, as in the middle of summer, there is now not enough to pump at all. The same scarcity of water exists, I believe, with regard to the watercress beds on the border of the county. That this condition of affairs is more acute than it was a few years since is also, I believe, a fact. What is the reason—the difference in the rainfall? Or are the great pumping stations of the Water Works, the Canal Company, and some of the new sewerage systems, responsible for the shrinkage? Can and should the springs stand the strain of all?

I am too well aware that the possessors of these pumping stations hold that the law affords them every immunity, however much they may encroach on the rights of the individual, but surely there must be a difference between a Water Company who, one presumes, does not pump more than sufficient for their requirements, and a Canal Company, working for profit, with their absolute unlimited capacity for consumption, provided their machinery is powerful enough, which the command of great capital gives them the opportunity to acquire. With these few preliminary remarks, I am,

Yours obediently,

Braziers End,
Tring, Sept. 22, 1902.

HENRY J. TURNER

TO THE EDITOR OF THE STANDARD.

SIR,—I have been reading with wonder (and envy) the article of your writer on the above subject in *The Standard* of last Saturday, in which he alludes to the copious rainfall of the previous week, the saturation of the land, stoppage of wheat sowing, and necessity for attending to drain outlets, and I feel quite curious to know to what parts of the country he refers.

Hereabouts we are suffering from unprecedented drought—ponds are dry and wells empty, and the outlook for water supply is most serious. As for seeing a drain run, we have almost forgotten what it looks like.

I am, Sir, your obedient servant,

CHRISTOPHER SMYTH.

Little Houghton, Northamptonshire, November 18.

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